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ABSTRACT

This document consists of four research reports and one research note focusing on several aspects of the cognitive and emotional development of young children. The first article explores two theories of the relationship between cognition and emotion, reporting on an investigation of that relationship in a simple learning task involving 60 Japanese infants under 7 months of age. The second article presents results of a longitudinal study of 29 firstborn Japanese infants growing up in urban middle-class nuclear families. Infants followed from birth through 23 months were observed in a standard Ainsworth strange situation; their behaviors in other situations were also analyzed. The third article proposes a conceptual model of the process by which children acquire knowledge through peer interaction in daily situations. The fourth article reports a study, of 4- to 6-year-old Japanese children, designed to test the hypothesis that information about social-cognitive ability and person orientation is required to predict whether or not children will show altruistic behavior in natural situations. Finally, the research note reports a study investigating 1- to 6-year-old Japanese children's ability to discriminate images of themselves from those of other people. (RH)

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伊藤則博

THE COGNITIVE-EMOTIONAL FUGUE

Michael Lewis, Margaret Wolan Sullivan and Linda Michalson
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> Fugue : The theme is first given out by one voice or part, and then, while that pursues its way, it is repeated by another at the interval of a fifth or a fourth, and so on, until all the parts have answered one by one, *continuing their several melodies and interweaving them in one complex and progressive whole, in which the theme is often lost and reappears.*

We have chosen the title "The Cognitive-Emotional Fugue" to stress the fact that cognition and emotion are neither separate nor independent aspects of behavior. Rather, both are elements of the same theme interwoven into a single composition. Both parts are continually chasing each other, like the parts of a fugue.

In this paper we will first characterize the relationship between emotion and cognition in terms of two traditional models. The first views emotion as a consequence of cognition and the second views emotion as an antecedent of cognition. Following this general discussion, attention will be given to an empirical investigation of the relationship between emotion and cognition in a simple learning task. The results of this study illustrate the central theme, namely, that emotion and cognition must be considered as parts of a complex and progressive whole in which both appear and disappear and each affects the other. Consequently, linear models that fail to capture this interplay are less satisfactory descriptions of the process than the model suggested by the fugue.

The relationship between cognition and emotion has been a topic of concern to many developmental theorists (Kagan, 1974 ; Lewis & Goldberg, 1969 ; McCall, 1972). Although recognizing that a certain level of cognitive development is necessary for the expression of complex emotions (e.g., guilt), these investigators suggest that early in development information processing is associated with emotional response. For example, the failure to assimilate an event is thought to produce wariness or fear, whereas mastery is likely to result in enjoyment (Kagan, 1974). In this model, emotion is the consequence of certain cognitive processes.

On the other hand, it is possible that emotion may precede cognitive processing. According to this model, emotion is a motive or drive with an action-producing or maintenance function (Darwin, 1872 ; Tomkins, 1962 ; Zajonc, 1980).

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EMOTION AS THE CONSEQUENCE OF COGNITION

The role of cognition in emotion is complex and varied. It can be considered in terms of the relationship of cognition to each component of emotion, including elicitors, expressions, and experiences. The need to distinguish among these components is critical since the role of cognition in each may be quite different (Lewis & Michalson, 1983). The tendency of some investigators to blur these distinctions often does not permit one to understand fully the various roles that cognition may play in emotion.

The most general theories that view emotion as a consequence of cognition are those that regard emotion as nothing but "interpretive cognitive actions and arousal" (e.g., Mandler, 1975, 1980 ; Royce & Diamond, 1980 ; Schachter & Singer, 1962). These theories award no special status to interpretive cognitive acts other than that they appear to have a higher status than emotion, since emotion is considered to be nothing more than a mixture of arousal and interpretation. However, cognition may enter into the emotional life of the organism in many other ways. Some of these are more direct than others and will be considered in the following discussion as the role of cognition in each aspect of emotion is explored.

THE ROLE OF COGNITION AT THE LEVEL OF ELICITORS

Cognition may influence emotion by determining the effect of the eliciting event. For instance, past associations of one stimulus with a noxious outcome or of another stimulus with a pleasant outcome are cognitive acts that may affect the organism's subsequent emotional response to the stimulus. Memories and associations constitute the cognitive interface between events that may have had no emotional consequence and those that do. Watson and Rayner (1920) laid the groundwork for the literature on conditioned emotional responses. They demonstrated that by associating a rat with a sudden loud noise a young child who had previously shown only approach behaviors to the rat could be conditioned to fear it. This fear was long-lasting and generalized to similar animals and objects. In this example the influence of cognition on the meaning of elicitors is seen in terms of the immediate and automatic associational value acquired by certain stimulus events. These events occur so rapidly that associational links rather than interpretive mechanisms seem to be employed.

Cognitive processing may play a more direct role in the actual creation of emotion through the interpretation of the elicitor. Theories that propose that emotions arise from certain cognitive activities can be broken down into two types : appraisal theories and discrepancy theories. Both are concerned with the quality of the elicitor.

APPRAISAL THEORIES

Appraisal theorise are based on the hypothesis that emotion results from a cognitive appraisal of a stimulus situation. For example, Arnold's (1960, 1970) theory of emotion, although containing both neurophysiological and cognitive elements, has as its central construct the cognitive act of appraisal. Appraisal is defined as the immediate, automatic evaluation of anything encountered as either good (i.e., beneficial to one's well-being) or bad (i.e., harmful to one's well-being). This appraisal results in a tendency to approach that which is evaluated as "good" and to avoid that which is

"bad." What is judged as neither "good" nor "bad" is ignored.

The basis of most appraisals is memory. A new object will evoke a memory of the feeling associated with past experiences with similar objects. Imagination may also play a role in the emotional process to the degree that before people act, they may try to imagine whether the consequence of that action will be beneficial or harmful. Both the appraisal of the conditions and the possibility of action determine the nature of the emotional tendency (e.g., fear or courage). If conscious judgment and deliberate decision warrant, the feeling tendency will result in overt action. Otherwise, the emotional tendency may be revealed only in emotional expressions, such as exclamations of joy.

Another example of an appraisal theory is provided by Lazarus (1966, 1968 ; Lazarus, Averill, & Optin, 1970). In this theory emotions are also believed to originate in particular kinds of cognitive appraisals. Basic to the theory is the view that organisms are constantly in the process of appraising and reappraising stimuli with regard to their personal relevance and whether or not the organism can cope. Such appraisals lead to certain kinds of activities (physiological, cognitive, and behavioral) in an attempt to adjust to the appraised situation. Appraisals can be either benign or threatening. Benign appraisals result in either an automatic, emotionless adaptation to a situation, reappraisal if additional information warrants, or positive emotional states. Threatening appraisals, on the other hand, lead either to direct action in an attempt to remove the threat or, when no direct action is possible, to benign reappraisal. As the organism continues to appraise and reappraise objects and events, fluctuations in emotion will be observed.

DISCREPANCY THEORIES

In a second type of cognitive theory that involves cognitive processing at the level of the elicitor, emotions are regarded as a product of certain discrepancies or incongruities between external events and internal representations or schemas. Incongruity presupposes differentiation, since the schema of a familiar referent must exist in the organism's mind and also must be utilized in order for the recognition of the discrepancy to occur. Hebb (1946, 1949) was the first to relate incongruity to emotion by demonstrating that fear is evoked by events highly discrepant from previous experience. The detached head of a monkey shown to other monkeys produces extreme fear, Hebb reasoned, because of its incongruity.

Berlyne (1960) suggested that unfamiliar or novel events may evoke either fear or pleasure, contingent on the conditions. Pleasure is evoked when the stimulus is novel or curious "to the right degree" (Berlyne, 1970). Learning in general takes place through conflict or disequilibrium ; if the organism lacks information about a stimulus event, uncertainty is generated. To reduce the uncertainty, the organism may actively explore the event. Thus, Berlyne made some attempt to link learning as well as emotion to discrepancy. As such, the theory is not a pure example of cognition leading to emotion, since the model provides also for emotion (i.e., uncertainty) to lead to learning.

Kagan (1974, 1978) has more recently promoted the incongruity hypothesis. He suggests that the organism's first response to a discrepancy or an unexpected change

in the physical parameters of a stimulus event is characterized by an inhibition of motor activity and decreased heart rate. This state is not one of emotion but rather is viewed as a "special state" with different outcomes depending on the cognitive processes that follow. For example, if an event is easily assimilated into the organism's cognitive schema without much effort, the organism will return to baseline levels of response. No emotion (i.e., boredom) is likely to be observed in this case. Events that cannot be assimilated, or are assimilated only with great difficulty, may result in fear. A special cognitive competence, thought to emerge between seven and nine months of age in Western infants, has been hypothesized as playing a major role in the child's emotional reaction to discrepant events. This competence has been described both as the "activation of hypotheses" (Kagan, 1974) and as the ability to perform simultaneous comparisons (Schaffer, 1974).

A somewhat different version of discrepancy theory has been presented by Siminov (1970). In this model emotion is defined as the consequence of the organism's "need" for information with respect to reaching a goal multiplied by the difference between "necessary informtion" and "available information". Information is viewed as the possibility of reaching a goal as a function of a particular communication. Siminov perceives the human organism as continually striving to attain the behavioral and physiological state of satisfied needs. The quantity of information vis-a-vis the attainment of this goal determines the emotional response. A lack of information will prevent the organism from organizing itself appropriately ; in this case, the nervous system is activated in a way to produce negative emotions. Positive emotions, in contrast, result from a surplus of information over and above that which is necessary for the satisfaction of needs. Specific emotions are classified in terms of (1) the strength of the need, (2) the extent of the informational deficiency or redundancy, and (3) the specificitiy of the action aimed at satisfying the need.

There are problems with the incongruity hypothesis, however (Lewis & Brooks, 1974). Often it is used as a *post hoc* explanation of the data. Since it is difficult to determine *a priori* the similarity or congruity of a series of events, prediction of a specific response is difficult. Different organisms may have different categories for comparing internal schema and external events. Depending on what schema is used as the referent, different orders of similarity may be generated even in the case of only one organism. For example, I may order my mother, my nephew, and a strange adult female differently. If familial relationship is the referent, mother and nephew are similar, whereas if gender is the referent, mother and strange adult female are similar. Therefore, in predicting the emotional outcome, both the event and the organism's strategy must be taken into account.

Another inadequacy of the incongruity hypothesis is the failure of familiar events consistently to elicit boredom or withdrawal. For example, the mother at times may elicit highly positive emotions. Emotional preferences based on familiarity may be more salient to the organism (Hunt, 1961) than discrepancy. There can be no question that children enjoy and show positive affect to familiar events, the mother being the best example.

Other problems occur when the incongruity hypothesis is evoked to explain fear.

Can incongruity theory explain why a physical approach often is necessary to elicit positive and negative responses? The capacity of organisms to develop specific aversions to individuals may be better explained by previous experience than by discrepancy (Bronson, 1972). Infants may be fearful of babysitters because in their past experiences the sitter's arrival has meant that the parent is about to leave. This fear has less to do with incongruity than with past experience. In general, organisms may evoke internal representations of past experiences that were painful or frightening and associate them with current events to produce fear.

In a study on the acquisition and violation of expectancy, Lewis and Goldberg (1969) suggested that the chief function of violation of expectancy (i.e., discrepancy) is to alert the organism. This involves a general arousal. In this study, arousal was measured by observing surprise expressions on the faces of three-to four-year-old children. Thirteen out of fourteen cases of surprise occurred in response to a violation of expectancy. The positive emotional behavior (smiling) occurred *after* the initial surprise response. It would appear that the discrepancy served to arouse the child, thereby producing a general emotional response without any hedonic tone. The specific emotion may depend on the context of the violation and other cognitions of the child at that point. For example, a mother's putting on a mask may lead to a violation of expectancy for infants. This would lead to arousal. Whether infants laugh or cry depends on the context, the infants' specific cognitions, and the infants' adaptive strategies for dealing with increased arousal. Infants may cry if the mask is put on when the mother is about to read a bedtime story but laugh when it is put on during playtime. In both cases infants perceive the discrepancy. However, in one case it produces fear because they understand it to be unrelated to bedtime and in the other it produces delight because they understand it to be related to play. Thus, the discrepancy of the mask has only an arousing effect ; other cognitions may determine its hedonic value.

Control over a stimulus event is another factor determining the organism's emotional response in a particular situation (Lewis, 1980). Gunnar (1980) reports that when infants are allowed to control the actions of an arousing toy they exhibit significantly fewer distress responses and are more willing to approach and interact with the toy than when they have no control over the toy.

Although discrepancy theorists, like appraisal theorists, argue that emotion is produced by particular cognitive processes, exactly how cognitive or information processing leads to an emotion is not understood. One possibility is that the cognitive-emotional connection may be prewired into the nervous system. When activated by certain elicitors, cognition may "release" particular emotional states. Exactly how such evolutionary necessity controls the activation of emotional states is difficult to determine, however. Cognitive processing itself might be considered an elicitor of subsequent emotions. From this point of view, the failure to assimilate an event, the violation of an expectancy, or even the approach of a stranger may constitute cognitive elicitors of emotional states through their action on as yet undefined receptors.

On the other hand, one could argue that the effect of these events is a function of their past association with negative outcomes. If this is the case, then these events

produce emotions because of their associational connections as described previously. Discrepancy theories generally focus on perturbations in the process rather than on the content of thought. Gunnar's (1980) demonstration of the effects of control over the stimulus on distress responses forces one to consider not only perturbations (i.e., discrepancies) but their nature as they relate to other factors, including past experience, the content of knowledge, and subsequent emotional behavior. In these ways–either through learning or prewired connections and interpretive acts–cognitive processes might produce emotion.

THE ROLE OF COGNITION AT THE LEVEL OF EMOTIONAL EXPRESSIONS

The role of cognition in emotion is perhaps most prominent at the level of emotional expression. Emotional expressions have been viewed as the direct consequence of an emotional state (Darwin, 1872 ; Ekman, Friesen, & Ellsworth, 1972 ; Izard, 1971, 1977 ; Tomkins, 1962, 1963) or as the natural consequence of an emotional state and past learning (Lewis & Michalson, 1982, 1983). The first position maintains that fixed neurosomatic connections exist between internal state changes and facial expressions as well as select postural and vocal behaviors. These natural, biologically determined connections are hypothesized to exist on the basis of the reported universality of facial expressions across a number of vastly different cultures (Ekman, 1972). If, in fact, facial, postural, and vocal behaviors are universal and have a one-to-one correspondence with emotional states, the need to postulate a cognitive role associated with emotional expressions becomes superfluous.

In contrast to more biologically-oriented theories, socialization theories point out the fact that expressive behavior does not necessarily have a one-to one correspondence with internal states. Upon reflection, it should be obvious that although facial expressions might be biologically connected to internal states, how and when to express emotions are rules clearly learned through socialization experiences. It is easily demonstrated that people often express emotions incongruent with internal emotional states. This could be due to knowledge that the expression of a particular emotion is inappropriate (such as expressing anger toward one's boss) or to a refusal to acknowledge a particular emotion (e. g., denying anger when insulted). There are many reasons why emotional expressions and emotional states may not be congruous (Lewis & Michalson, 1983). In all cases the need to postulate some form of learning is evident, a need that suggests a role for cognitive processing in the expression of emotion.

Because of the influence of socialization on emotional expression, some theorists have argued that "purer" (i. e., biologically based) emotional expreesions can be observed better during the early part of the life cycle, prior to the learning of the rules for their expression (e.g., Izard & Buechler, 1979). However, maternal responsivity to infants' emotional expressions is already differentiated by the time the infants are three months old (Brooks-Gunn & Lewis, 1982). The fact that mothers are less likely to reinforce fretting and crying than smiling suggests that socialization practices probably exert differential impacts on emotional expressions from the beginning of life. A more complete discussion of this particular topic can be found in Lewis and Michalson (1983).

THE ROLE OF COGNITION AT THE LEVEL OF EMOTIONAL EXPERIENCES

Cognitive processes may affect emotional experience in at least two ways : (1) in the perception of unique physiological changes within one's own body or (2) in the cognitve interpretation and evaluation of a general arousal state. The first role for cognition is illustrated in James' (1884, 1890) theory of emotion. For James it is the *perception* of the bodily changes as they occur that constitutes the emotion. Crying makes one sad, trembling makes one angry, and smiling makes one happy. Emotional differentiation is a function of the occurrence and perception of different patterns of bodily changes unique to particular emotional states. All that is required cognitively on the organism's part is the perception of these internal changes in state. Tomkins (1962, 1963, 1970) also believes that differences in emotional experience originate from differential patterns of body responses (primarily facial) and that a minimal amount of cognitive processing is involved beyond the perception or registration of such changes. The awareness of these responses constitutes the experience of the emotion.

Another way cognition may enter into emotional experience is in the interpretation and evaluation of a general arousal state. For Schachter and Singer (1962) emotion consists of general physiological arousal rather than specific patterns of physiological changes. Since this general arousal state is common to all emotions, the organism cannot make distinctions in emotional experience based solely on differences in physiological cues. Rather some cognitive interpretation and evaluation of the arousal is necessary. This "cognitive context" is provided by cues external to the organism. From knowledge of the situation in which the arousal occurs, including the social behavior of other people, the organism creates, as it were, the emotional experience.

In Mandler's (1975, 1980) theory of emotion, cognition seems to play a dual role in emotion, first as an elicitor of an emotional state, then as an interpretive-evaluative act. For Mandler, the interruption of ongoing thought or behavior (a discrepancy or conflict) produces arousal. This arousal is quite general and is responsible only for the intensity of the experience ; it is not a specific emotional reaction. The specific quality of the emotion produced by the interruption depends on the accompanying cognitive evaluation of the internal state and the environment.

Although in Mandler's theory autonomic reactions only produce emotional experiences in conjunction with cognitive evaluations (that are usually previously acquired or assigned), cognitive evaluations and judgments may also occur in the absence of autonomic activity. Thus, one can talk about being happy or sad without the accompanying state of happiness or sadness. Buck (1980) reviews studies in which patients with spinal cord lesions (and thus without physical sensation) report they experience "a cognitive kind of emotion" in the absence of any emotional state. In Mandler's view there are also instances in which "pure" cognitive activity can generate autonomic activity and produce a "full-blown emotional reaction." The possibility of emotional experience being retrieved in this instance would depend on the retrieval of the appropriate context.

It is important to understand that whether a theory of emotion posits either a specific physiological state or a general state such as arousal, the interpretation of that state is what gives emotions their particular phenomenological quality. For theories

where general arousal is the internal state of emotion, specific emotional experiences are facilitated by the individual's interpretation, knowledge about, and direct observation of the situation in which arousal takes place. This can occur either through the observation of the expressions of others in the situation or through knowledge of what emotional state is "appropriate" to that particular situation (e.g., we know to feel sad at funerals and not when someone wins a lottery). For those theories in which emotional state is specific to a particular emotion, the interpretation of that state may rely less on external events and more on specific somatic, visceral, or neural responses. Making a face distinctive to a specific emotion may generate the corresponding emotional experience (Laird, 1974), presumably because the subject has produced a set of unique responses related only to that specific emotion.

Although cognitive theories of emotion stress the need to consider the role of appraisal as well as the role of physiological and situational cues that play a role in emotion, more work is needed in detailing the particular cognitive processes that affect various emotional responses and in specifying their antecedent conditions. However, there can be no doubt that the perception of the stimulus plus an evaluation of it with respect to its personal significance are contributing factors to some emotions.

COGNITION AS THE CONSEQUENCE OF EMOTION

The model that depicts cognition as the consequence of emotion parallels the model of emotion as the consequence of cognition. However, most theorists have addressed the topic somewhat differently. They ask whether it is possible to feel without thinking. More to the point is the issue of whether emotion can produce different ways of thinking or different cognitive processes.

There is at least one theory (although far from complete) that suggests that thought may be the consequence of certain feeling states. In ego development theory, the delay of immediate gratification and the resulting emotion force the organism to develop more mature thought processes. Cognitive structures are produced by delays through processes labeled "secondary thought" (Freud, 1960) or "elaborated thought" (e. g., Hartmann, 1958). For instance, when individuals cannot eat immediately when they are hungry, they may imagine themselves eating in order to feel good. Imagination is the consequence of an unfilled (i.e., negative) emotional state. The notion that emotion precedes cognition has recently resurfaced (Zajonc, 1980). Emotion may be viewed as preceding cognitions from three perspectives : as motive, marker, and instigator.

EMOTIONS AS MOTIVES

Since Darwin (1872), the notion of emotions as motives to act has been popular in many contemporary theories of emotion. Cognitive activity can be thought of as a subclass of the general category of action or behavior. In the following discussion, the general category of action is considered but the reader should understand that this discussion is meant to apply to cognitive actions as well. Theories that consider emotions as motives to explain action can be divided into two classes : (1) those that view emotion as a consequence of an action pattern and thereby reinforcing that

pattern and (2) those that view emotion as causing an action pattern based on the evolutionary history of the species.

The central issue of the hedonic tradition is the belief that people act (or think) in such ways as to produce pleasure and avoid pain. The emotional consequences of an action (or thought) are regarded as the primary cause of that action. Thought patterns that are likely to result in pleasure or to reduce pain will be taken ; thought patterns that are likely to lead to pain will not be taken (e. g., consider Festinger's [1957] notion of cognitive dissonance).

This view of emotions as motivating action through the emotinal consequences of that action appears reasonable. For example, students may study for examinations because it feels good to pass and it feels bad to fail ; children engage in symbolic play in order to experience the pleasures in solving a problem. It should be noted that this view of emotion considers behavior to be motivated by the *possibility* of its emotional consequence. Even though the emotional experience occurs after the action, it is believed that the reinforcement value of this experience serves to produce the same set of behaviors in order to re-experience the particular emotion. So although emotion is initially a consequence of action, the expectation or memory of the emotional state may precede and influence action.

If one thinks of emotion in this way, then emotions, especially feeling good and feeling bad, act as reinforcers to particular actions or thoughts. In many cases, these hedonic reinforcers seem to be unlearned. For example, it is unlikely that the good feeling produced by eating when hungry is learned. Rather, eating feels good because of an innate biological connection between food in the digestive tract and relief from hunger. On the other hand, some emotional reinforcers seem, at least at first glance, to be learned. There is no intrinsic reason that it should feel good to get an "A" on a French examination. The issue, however, becomes more complex when one moves from the particular event, such as doing well on a test, to its more general form, such as being competent. It may be the case that being successful in anything (depending on the cultural definition of success) is rewarding(i.e., produces a positive state). In this event, the developmental issue pertains only to specifying which particular actions will be associated with positive or negative states.

In the above discussion, we have focused on emotion as the reinforcing consequence of behavior. However, emotion may not be only the reinforcing outcome of action, but also its antecedent. This view of emotion is usually associated with biological explanations of emotion. Darwin (1872), the source of the evolutionary tradition in the study of emotion, argues that the process of evolution applies not only to anatomical structures but to intellectual and expressive behaviors as well. Emotions are by their nature associated with action patterns that the organism needs for survival. For example, the sight of a predator will elicit fear in the organism, the action pattern of which is to flee. Or, a baby's cry will elicit nurturance in the mother with a concomitant behavioral repertoire of nursing, holding, or retrieving the infant. Viewed in this way, emotion is both a state of the organism and a response that is basic to life and survival. In all cases of positive and negative emotions the emotional elicitor produces specific action patterns (including cognitions) as a part of the emotion.

Plutchik (1980) enumerates eight basic functional patterns of behavior that have adaptive significance for all organisms in their struggle for survival. The prototypic patterns include incorporation, rejection, destruction, protection, reproduction, reintegration, orientation, and exploration. These basic adaptive patterns are thought to be the functional basis for all emotions recognized in humans and animals. Eight emotions accompany the functional patterns : acceptance, disgust, anger, fear, joy, sadness, surprise, and expectancy. Although the specific behaviors that accompany these patterns may vary across different species, their survival function is common to all species.

Recently, Zajonc (1980) has offered a view similar to the evolutionary position. For Zajonc, some of the behaviors associated with an emotional state may have "hard wire" cognitive representations ; that is, they may be independent of cognitive systems, and in fact may precede perceptual and cognitive operations. Zajonc discusses the primacy of emotion with regard to preferences and attitudes, but his argument is essentially that emotion "accompanies all cognitions, that it arises early in the process of registration and retrieval...and it derives from a parallel, separate, and partly independent system in the organism" (p.154). In short, emotions may be associated with basic adaptive functions and have as their biological consequence a set of dispositions, including actions as well as thoughts.

EMOTIONS AS MARKERS

Much attention has been focused on the roles of "hot" versus "cold" cognitions. The general assumption underlying this thought is that many cognitive processes have different levels of efficiency or outcomes depending on whether these cognitive processes are tagged with specific emotional tones (see Zajonc [1980] for a comprehensive review of this topic). Tow effects of markers are briefly considered here. First, one might argue that certain cognitive processes marked with emotion might be more efficient than those not marked. For example, the retrieval of past events, from both short term and long term memory, is facilitated by affective markers (Norman & Rumelhart, 1975). It is reasonable to assume that information may enter memory not only as a function of the content or sequence of the material, but also as a function of the emotional tag. Clearly the schema of a man in a white coat is more likely to be remembered if it is associated with fear than the schema of a man in a white coat than is not marked with fear.

Second, markers may also be associated with the emotional content of events as they relate to the emotional state of the organism. For example, Bower's (1981) research indicates that emotions may have a powerful influence on cognitive processes, including free recall, imaginative fantasies, and social perception. Bower has found that people recall more events that are affectively congruent with their mood during recall. Here, emotions as markers refer not only to the emotional tag attached to the cognitive event but also to the emotional state of the subject as the subject interacts with the cognitive event.

EMOTIONS AS INSTIGATORS

The third role of emotion in cognition addresses the following question : Do certain feelings necessarily lead people to think in particular ways ? One way to approach this issue is to consider thought in the same way that one might consider other action patterns as related to specific emotions. Emotions may not only lead in some biological fashion to action patterns (Plutchik, 1980) but in fact emotions may produce specific thinking patterns.

One aspect of this issue is related to the nature or the content of the thought. For instance, someone may tell you that your cousin was hit by a car, or someone may tell you that your cousin won the lottery. The emotions produced by the information about your cousin in these two cases might influence your subsequent thoughts.

SUMMARY

In the preceding section, two models of the relationship between cognition and emotion were considered in an attempt to review some of the major themes underlying empirical inquiry. From this discussion one soon realizes that no single unidirectional model is sufficient. Cognition leads to emotion and emotion leads to cognition. Cognition and emotion must be viewed as continual processes that are interwoven in a highly complex way such that to separate them is to distort the phenomenon. The continuous nature of these processes is such that to separate them into arbitrary temporal units in fact serves to create an artifical temporal and causal sequence. Although a unidirectional model is appealing from an empiricist's point of view, the artificial boundaries imposed by such a model not only restrict our perspective but also generate theories that are too simple, ones that assume the process begins with either a cognition or an emotion.

An alternative view can be derived from Hofsteader's (1980) book, *Gödel, Escher, Bach.* This alternative model depicts an interplay of these forces or themes without beginning or end. This view is illustrated in Escher's art, in much of Escher's work, the theme of movement without beginning and end is depicted. So, too, cognition and emotion can be conceived as a continuous interweaving of behavior without beginning or end.

AN EMPIRICAL INVESTIGATION OF EMOTION AND LEARNING

To explore the empirical relationship between cognition and emotion, we have chosen to look at infants in a simple contingency learning situation. In this situation the children must discover that their actions systematically result in a predictable outcome. Thus, the study involves simple motor behaviors that reflect learning. At the same time facial expressions occur that can be used to measure changes in assumed emotional states. By the joint measurement of learning and facial expressions, it is possible to observe the interconnections between cognition and emotion. Before presenting this data, however, we will briefly review what is known about the role of emotion in learning. The empirical studies to date almost exclusively view emotion as a consequence of learning.

EMOTION AND LEARNING : A REVIEW

Lewis and Goldberg (1969) described a theory of generalized expectancy, or "learning to learn," in which they proposed that competence develops over time as the result of various contingency experiences. Similar to Piaget's (1952) notion of circular reactions, contingency experiences may be defined as "if-then" relationships. For example, *if* the infant pulls on a string, *then* a mobile revolves. If specific behavioral responses to contingent outcomes increase with time, the infant is said to have learned the contingency. Continued experience with sources of contingent stimulation is hypothesized to result in a generalized expectation that one can act upon and manipulate the environment and a motivation to do so in novel situations. Such a motivation should manifest itself in increased exploratory behavior and positive affect.

The display of positive affect as a direct consequence of contingent stimulation was reported by Watson (1966, 1972). Over the course of a two-week experience with a rotating stabile, Watson reported increased incidence of smiling and cooing only among those infants for whom stabile activation was contingent upon pillow presses. Together with Lewis and Goldberg's(1969) work, the data suggest that a major consequence of contingent learning may be an emotional change. Infants who learn exhibit more positive social behavior.

A number of investigators have followed Watson's lead and have attempted to document changes in emotional behaviors (i.e., smiling, vocalization, and crying) during contingency experience (Sullivan, Rovee-Collier, & Tynes, 1979). Brinker and Lewis (1981) report increased smiling and vocalization and decreased crying in young, severely handicapped children in response to simple contingencies. Thus, there is some evidence of positive and negative affect changes concomitant with contingency experience.

This very brief review of the contingency literature indicates that emotional responses occur at some point during the learning process. When they occur–whether at the beginning, the end, or throughout the process–has not yet been determined. Smiling and vocalizing may be the consequence of learning and mastery (i.e., it feels good !). Alternatively, they may be a necessary prerequisite for learning (i.e., I cannot learn unless all is well). In still another view, positive emotions may not occur only at beginning or at end of the learning experience, but during both phases or even in between. Nor is it clear that only positive emotions accompany the learning process ; they are the only emotions that have been measured. What about negative feelings, such as stress and frustration, that accompany increased arousal ? Does the infant's ability to "cope" with stress affect learning and at what stage ?

The two theoretical positions–cognition leads to emotion or emotion leads to cognition–suggest several alternative models regarding emotion and the learning process :

1. Positive emotion occurs as a consequent behavior, indexing the realization of the contingency. As such, it is greatest when the response has peaked and it will decline as the infant becomes bored, satiated, or fatigued (see figure 1A).

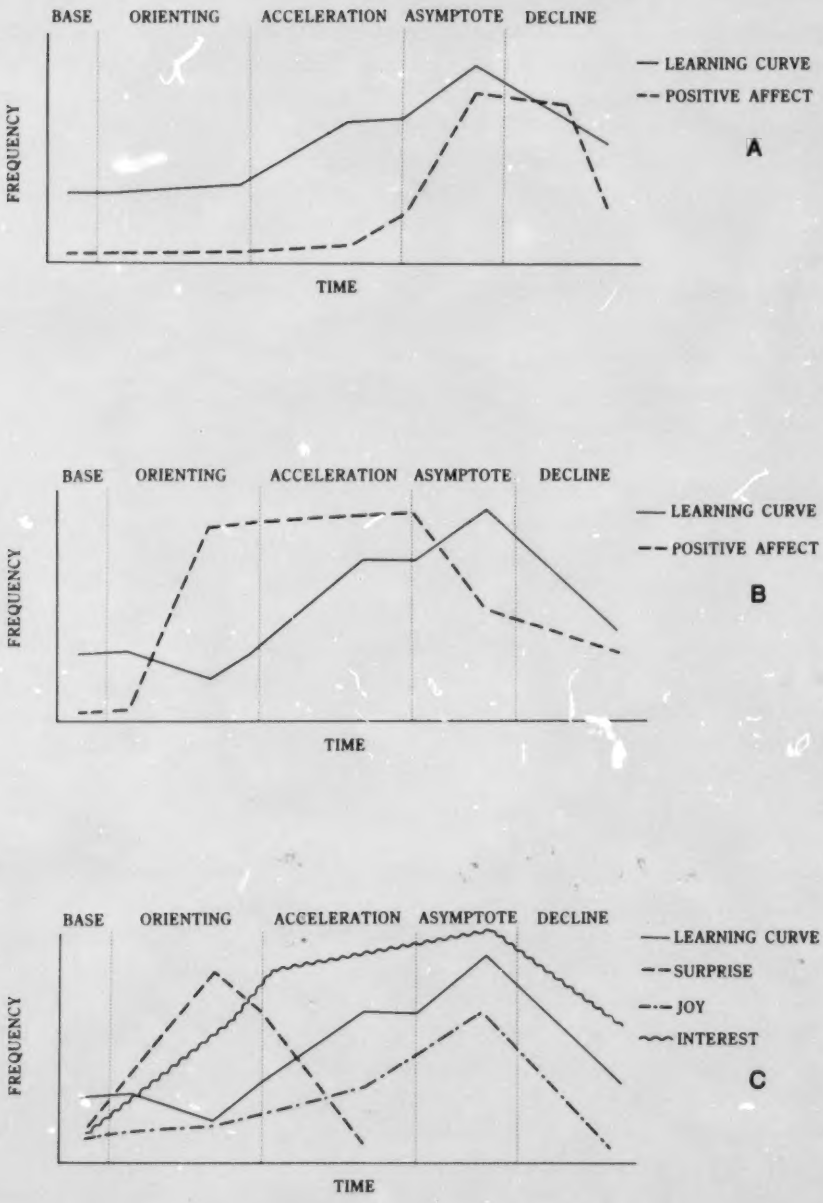

FIGURE 1 Models of learning and affect

2. Positive emotion occurs before the actual recognition of the contingency. It is not necessary to know what the contingency is before being pleased with the situation. Positive emotion and the corresponding absence of negative emotion signal the infant's pleasure at the stimulus situation–in other words, a like-dislike reaction made prior to any other cognition. Emotion will be elevated with respect to a base period early in the session prior to contingency perception and will decrease after the infant's response peaks (see figure 1B).

3. If, as we propose, emotion and cognition are interwoven, then we might expect that some emotions precede cognition, which in turn leads to new emotions and cognitions. For example, early aspects of learning may depend on increased interest and surprise that keep the infant engaged and oriented. The enjoyment and orientation lead to improved performance, which in turn leads to increased interest. Increased interest leads to further performance and mastery, which in turn leads to enjoyment. The interplay between these two processes and the differential timing and sequence of different emotional states is illustrated in figure 1C.

THE CONTINGENCY LEARNING STUDY

The subjects of the contingency learning study were among 60 infants who participated in a larger study of learning in the first six months of life. In this study infants sat in front of a contingency apparatus that was designed to deliver a three-second presentation of an audio-visual stimulus (a color slide of a happy baby accompanied by a recording of the *Sesame Street* theme song). Stimulus onset was contingent upon an armpull response by the infant. Armpull responses were automatically recorded by means of a ribbon connected to a velcro bracelet worn on the subject's wrist. Deflection of the ribbon activated a microswitch in a lever mounted above the subject. Subjects remained in the session as long as they continued to respond. Two minutes of inactivity or 30 seconds of fussy behavior or crying were the criteria for terminating the session. In addition to on-line recording of armpull responses, attention, smiling, and vocalizing behaviors were recorded and videotape recordings were made of facial expressions throughout the course of the experimental session.

From the sample of 60 infants five six-month-old infants (three boys and two girls) were selected randomly, with the only criteria being that they exhibited classic and well-differentiated learning curves. The temporal parameters of each learning curve were identified and each of the curves was segmented into the following phases :

Base : one minute of nonreinforcement (1).

Initial orientation to stimulus event : first minute following base (2). This minute is the infant's first encounter with the contingent stimulus.

Contingency awareness : one minute prior to response acceleration (3) (that point where armpull responses exceeded and stayed above base line) as well as the first minute following this point (4). Although some children's learning curves showed more rapid acceleration than others, the point of acceleration and the minute prior to and following this point were constant across subjects.

Response asymptote : one minute prior to the point of highest armpull response (5) as well as the first minute of the highest level (6).

Post-asymptote : first minute prior to decline in armpull response (7), first minute after the sustained decline (8), and the last minute of the session (9). Typically, responses dropped off quite dramatically during this period, although responding did not invariable return to base line level. The drop off in response may signify either habituation to the contingency problem or fatigue.

Because individual session lengths and rates of learning were variable, the length of each phase was also variable. However, by carefully marking the specific phases of each curve, comparable points of the learning curve were sampled and qualitatively similar moments during the learning experience were compared.

CODING OF FACIAL BEHAVIOR

Facial movements were coded from videotapes of the infants using the Maximally Discriminative Facial Movement Coding System, referred to as "Max" (Izard, 1979). Max was chosen because training manuals are available and it can be used reliably (Izard & Dougherty, 1982). In addition to coding facial movements, a number of other behaviors of particular interest in a contingency experiment were also recorded. Orientation of the head when other than a frontal full face served as an index of inattention to the contingency consequence. Infants might look away from the reinforcing stimulus either by casting their eyes down (which is codable in Max) or by looking to either side (which is not codable). Looks at hand is an interesting behavior in the contingency context since it suggests an awareness of the ribbon and possibly perception of the means-end contingency. Looks at hand was scored when both the subject's hand with the velcro bracelet and the subject's eyes were in view and the subject's gaze was oriented toward that hand.

Sucking lower lip, thumb sucking, and/or hand sucking were also coded for several reasons. First, their obstruction of the mouth clearly limits judgments of emotion to the rating of only the upper region of the face. It is useful to know the reason that an important emotional cue is missing. Second, sucking and other oral behaviors, although not emotional behaviors themselves, may be motivated by stress or boredom (i.e., they may serve pacifying, comforting, or self-stimulating functions). Finally, vocalizing, fussing, and crying were coded.

The coder sampled infants' facial behavior from the videotapes in three-second segments based on the predetermined phase of the learning curve : (1) one minute of base line, (2) the first 60 seconds of the contingency, (3) 60 seconds prior to response acceleration, (4) 60 seconds of initial acceleration, (5) 60 second prior to peak response, (6) first 60 seconds after peak response, (7) 60 seconds prior to sustained decline, (8) first 60 seconds of decline, and (9) last 60 seconds in the session. A total of nine minutes of facial behavior was coded for each subject.

During the coding, four passes were made through each tape. In the first three, with the volume off and in slow speed, brow, eye, and mouth regions of the face were coded. During the fourth pass, with the volume on and at normal speed, vocalization and fuss-cry were noted. To code facial expressions, the coder noted all codable movements in sequence for each three-second segment of behavior. One code per three-second segment was most common, although two to three facial changes occa-

sionally occurred, particularly during phases 2 and 3. If a facial movement began in one segment and persisted into the following segment, it was coded only for the interval in which it first appeared. Duration of appearance changes were not measured. In our experience it appeared that some facial expressions, such as interest, could be relatively enduring while others, such as enjoyment (i.e., smiling), were typically very brief. The dependent variable then is the number of three-second intervals in which a given expression was first visible without regard to its duration.

RESULTS

Figures 2, 3, and 4 present the mean number of expressed emotions as a function of the specific phases of the learning curve. It should be kept in mind that the temporal parameters associated with each phase are different for each subject. Nevertheless, the coding system allows for the observation of emotional responses by phase across subjects. Since three-second intervals across a minute of coding were used, the maximum number of facial expressions per minute is 20. However, since more than one facial expression might occur in a three-second period, each facial expression could occur a maximum 20 times per minute. Thus, the total number of different expressions per coded period can (and indeed sometimes does) total more than 20.

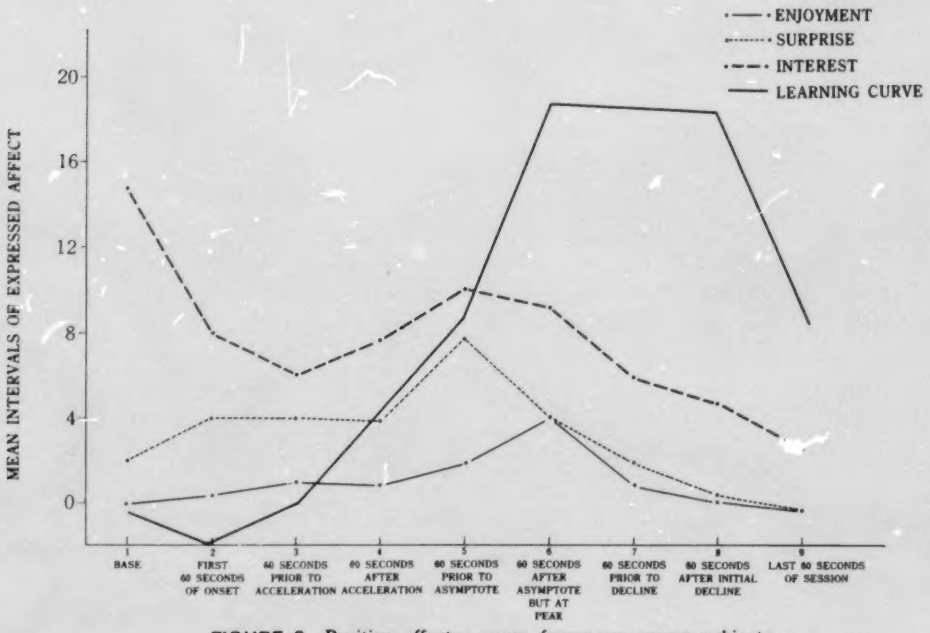

FIGURE 2 Positive affects: mean frequency across subjects

The positive emotions of interest, surprise, and enjoyment have distinct patterns in relation to the learning curve (see figure 2). During the base period (1), after the child has been placed in this new situation, interest is high while surprise and enjoy-

ment are quite low. In fact, only a small amount of surprise is observed. At the onset of the reinforcement (2), interest expressions decline markedly and surprise expressions increase slightly ; enjoyment remains low. The same pattern continues into the last phase of the orienting period (3). The acceleration phase of learning (4, 5) is characterized by an increase in interest and surprise and also a slight increase in enjoyment. This period is marked by the highest level of surprise and interest (except for the base period when interest was also high). In the asymptotic phase (6,7) interest and surprise decline but enjoyment peaks. Following this phase of learning, all positive expressions decline. This general pattern was shown for all five subjects. In four out of five subjects, surprise preceded enjoyment ; all five subjects showed a decline and then an increase in interest, and all showed a decline in positive expressions after learning.

The data reveal increases in positive expressions around the point of learning acquisition. Surprise and interest peak during the acquisition phase and enjoyment peaks at asymptote. Lewis and Goldberg (1969), discussing violation of expectancy, suggest that surprise and interest (more general emotions) should occur prior to the appearance of specific emotions such as joy or fear. The patterns found in the current study support the notion that surprise precedes enjoyment and thereby indicate that the process of acquiring information may be related to arousal with the final discovery related to enjoyment.

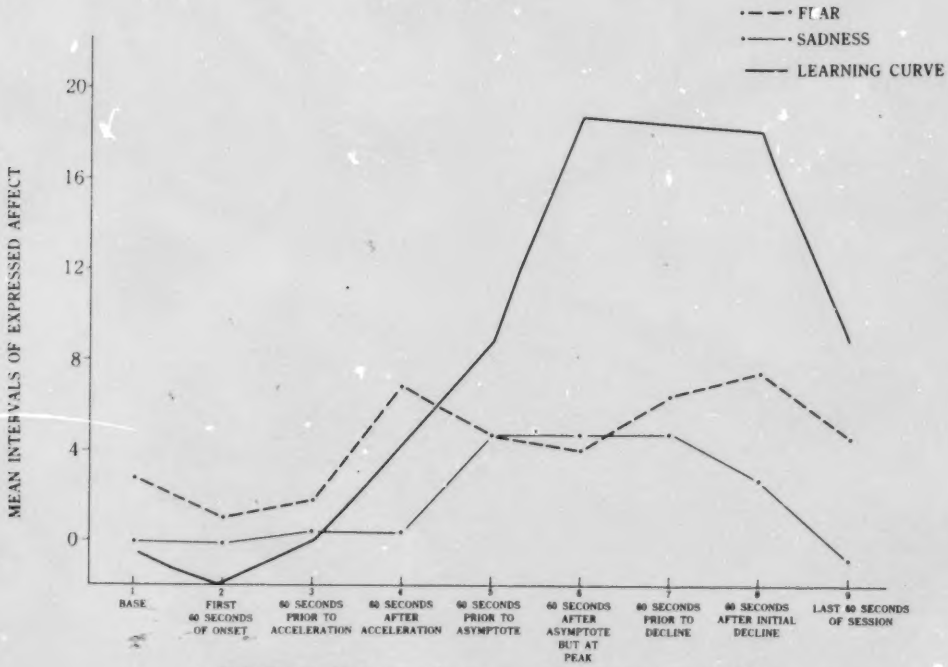

FIGURE 3 Negative affects: mean frequency across subjects

With regard to expressions of negative emotions, almost none are observed during base (1) (see figure 3). Negative expressions are most frequent during the

orientation phase (2, 3), with fear reaching its highest level during this period. During the acquisition phase (4, 5), fear declines and remains low thereafter. This pattern held for all five subjects. Sadness shows relatively little change across the learning process, except during the post-asymptotic period (8, 9). At this point, as interest and other positive expressions decline, sadness reaches its highest point (perhaps indicating there are no new mountains to climb). Four out of five subjects showed this pattern. The negative facial expressions appear to be reciprocals of the positive expressions.

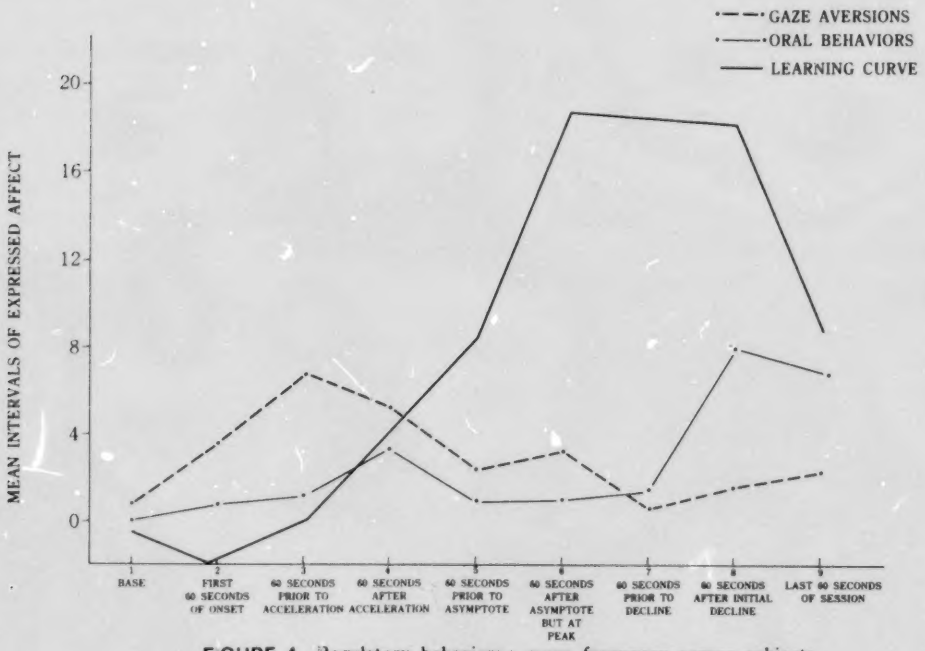

FIGURE 4 Regulatory behaviors: mean frequency across subjects

Figure 4 presents the sequence of appearance for the two self-regulating behaviors, gaze aversion and oral behavior. These behaviors follow still a different pattern of occurrence. Relatively little gaze aversion or oral behavior is observed during the base (1) or orienting (2, 3) phases. Both classes of behavior increase markedly during the acceleration phase (4) and remain high throughout the rest of the session, although some decline can be seen during the last phase (9). Most notably, these behaviors increase at the time when negative expressions decline and positive expressions increase. However, they remain high during the asymptote and post-asymptote phases (6, 7, 8, 9) when positive expressions decline. Although more individual variations occurred in these patterns compared to the others, however, four of the five subjects showed a decline in self-regulatory behavior in the last minute of the session (9).

Thus far, our discussion has focused on patterns of facial expressions with little attention given to the absolute levels of their occurrence. Without doubt, the most

frequent facial expression was interest. This is not surprising, since the task was designed specifically to interest children. The next most frequent responses were surprise and the control behaviors. Enjoyment, fear, and sadness were relatively infrequent expressions. In fact, in only one phase did enjoyment occur more than 20% of the time. Fear, on the other hand, occurred in three periods more than 20% of the time. The frequency of appearance of sadness was comparable to that of fear.

THE FUGUE

The results of the contingency learning study bear on several issues. First, consider the metaphor of a fugue of cognition and emotion. The infant is placed in a new situation. The fugue begins. Surprise is present and interest is high. The experiment starts ; reinforcement is delivered for an armpull response. For the infant, something new is happening ; surprise and fear increase, interest decreases. The activity level of the infant also decreases as armpulling declines below base line level. This dip in frequency of response may reflect the infant's thought : "Something is happening. What is going on ?" We label this period the orienting phase because of the infant's cessation of activity and increased vigilance and/or wariness. The increase in fear may reflect the infant's lack of information and control over the nex event.

The decline in activity serves to diminish the reinforcement. A response causes reinforcement to reoccur. During this phase, which is viewed as the end of orientation and the beginning of acceleration, the infant "begins to learn" the relationship between action and outcome. Fear decreases ; interest begins to rise. During the acquisition phase, interest and surprise continue to increase as fear declines. The infant continues to be aroused and it now becomes necessary to modulate this arousal. Self-regulatory behaviors (gaze aversion and oral activity) appear for this purpose and occur at relatively high levels.

Learning is achieved by the asymptotic phase when enjoyment peaks. Fear remains low and self-regulatory behaviors remain high. Following the solution of the problem, armpulling responses decline along with many of the emotional expressions. This decline may reflect a drop in arousal. With the decline in arousal, the infant no longer has need for self-regulatory behaviors, which remained high until the beginning of the post-asymptotic phase. Cognitive solution brings enjoyment, a decline in arousal, and a decline in self-regulatory behavior.

During the post-asymptotic phase an interesting emotional expression appears, sadness. This expression may be a function of several factors. One possibility is that sadness is associated with fatigue and upset. If this is the case, however, one would also expect to see an increase in self-regulatory responses, particularly oral behavior. This did not occur. The large increase in sadness may be the consequence of a post-solution recoil. Such a process might be not unlike that described by adults who report depression following the successful completion of an activity (i.e., no more mountains to climb).

If the cognitive-emotional preocess is viewed in terms of well defined temporal bouts, each of which has a definite beginning and an end, then one would expect to observe a decline in all responses at the end of the experiment. The increase in

sadness at the end of the session, however, suggests that the end constitutes an artificial event imposed by the experimenter on the ongoing flow of emotion and cognition. One might imagine that this negative emotion serves as the first note of the next sequence in the cognitive-emotional fugue. In other words, the post-completion blues may be a vital factor in redirecting the individual to new tasks.

THE ORIENTING REFLEX

Another issue raised by the data has to do with the orienting response and learning. It has been argued that in order for learning to take place there must be a habituation of the orienting respose (Sokolov, 1963). Our data suggest that this is the case. The orienting reaction that occurs at the onset of reinforcement produces a complex set of responses. First, armpulling behavior declines as expected, since orienting results in the cessation of activity (Lewis, 1969). In addition, a fear response, perhaps a sign of wariness and/or vigilance, increases during the orienting phase only to decline shortly thereafter. It is following this orienting period that learning seems to occur. Once the subject's armpulling response returns to base line, armpulling gradually increases. In addition, once fear diminishes, interest begins to increase. It seems that the habituation of the orienting response consists of a decline in fear, a resumption of activity, and an increase in interest.

It should be noted that this change in emotional behavior accompanying the habituation of orienting has as a concomitant response an increase in self-regulatory behavior. The self-regulation may facilitate the emotion switch. Thus, for example, in order for the infant to become less fearful and more interested, it may be necessary that infants regulate themselves through self-stimulation. Although there are no data to support this view, the control of fear through self-regulation may allow an increase in interest and learning.

The habituation of the orienting respone appears to be comprised of emotional states nonconducive to learning. In this particular study, the cessation of activity was associated with wariness. Not until infants could respond did they learn the association between armpulling and outcome. Self-regulation served to reduce this wariness, thereby causing a reduction in the orienting reflex. Once the orienting reflex was habituated, behavior resumed. In this sense, the orienting reflex is envisioned not as a cognitive but as an emotional process.

INDIVIDUAL DIFFERENCES

Individual subject characteristics may also be implicated in the cognitive emotional process. Individual differences may include purely cognitive variables, such as the ability to recognize, store, and retrieve information about the cooccurrence of action and outcome. Of particular interest, however, are individual differences that may be related to the emotional components of this process. At each stage of learning, individual differences appeared in terms of the amount of emotion expressed, although relatively few individual differences were observed in the type of emotion expressed.

The variability among subjects was most pronounced on self-regulatory responses. Such individual differences may be related to what has been called

"temperament." Part of the child's task in the cognitive-emotional process is to regulate the level of negative emotion associated with the early phases of learning. This regulation may vary as a function both of (1) the amount of negative emotion initially produced and (2) the efficiency of the child's ability to regulate this negative emotion. Both may be features of the temperament dimensions of excitability and soothability (Thomas, Chess, Birch, Hertzig, & Korn, 1963). For infants with difficult temperaments, the intense emotion associated with orienting may overwhelm the infant and prevent habituation. These children may become increasingly fretful and ultimately drop out of the learning situation. Alternatively, other infants with difficult temperaments might take a prolonged period to regulate the orienting response, thereby demonstrating learning only much later. For some of these infants who gain control later, new state variables, such as fatigue, might appear prior to the learning phase and they too might drop out of the learning situation. From another point of view, lethargic children (sometimes considered to have easy temperaments) may not become sufficiently aroused to orient ; thus, they may not be able to initiate the learning process. Down's syndrome children may be a case in point. These children typically have low muscle tone, are lethargic, and are often reported to have easy temperaments. Their learning problems may in fact result from an inability to become activated.

One would expect that in the study of the cognitive-emotional interface, individual differences in the type of emotion as well as in the amount of emotion expressed would be found. Although the five subjects in the present study were remarkably similar in terms of the types of emotions expressed, there were some idiosyncratic facial appearances, which might be attributed to measurement error. It is not unlikely that individual differences exist in the cognitive-emotional interface. Indeed, with age individual differences in some of the minor threads of the process migh become even more visible, playing a major role in idiosyncratic behavior. Individual differences, however, should not trouble one. To invoke the metaphor of the fugue, "there are standard kinds of things to do but not so standard that one can merely compose a fugue by formula" (Hofstadter, 1981, p. 9).

In the present investigation we measured emotional expression, assuming a one-to-one correspondence exists between expression and internal emotional states. As we argued earlier, however, the relationship between expression and state is complex (Lewis & Michalson, 1983). Early facial expressions appear too differentiated vis-a-vis hypothesized internal states to allow one to assume a one-to-one correspondence between the two. Moreover, socializing agents soon teach children through a variety of means how to mask and alter facial expressions, and perhaps even when to display certain faces. Thus, a certain amount of caution must be taken in interpreting these data. It may be that emotional expressions rather than emotional states are the concomitants of learning.

We have used the metaphor of the fugue in an attempt to argue that (1) the separation of components, in this case cognition and emotion, may be an inappropriate way of viewing the relationship between elements and (2) a linear model of the relationship between these components is inadequate. In conceptualizing the relationship of cognition and emotion, neither should be described as causing the other ;

rather, each chases the other in an endless fugue.

REFERENCES

Arnold, M. B. *Emotion and personality* (2 vols.). New York : Columbia University Press, 1960.

Arnold, M. B. Brain function in emotion : A phenomenological analysis. In P. Black (Ed.), *Physiological correlates of emotion.* New York : Academic Press, 1970.

Berlyne, D. E. Children's reasoning and thinking. In P. Mussen (Ed.), *Carmichael's manual of child psychology* (Vol. 1). New York : Wiley, 1970.

Berlyne, D. E. *Conflict, arousal and curiosity.* New York : McGraw-Hill, 1960.

Brinker, R. P., & Lewis, M. Contingency intervention in infancy. In J. Anderson & J. Cox (Eds.), *Curriculum materials for high risk and handicapped infants.* Chapel Hill, N. C. : Technical Assistance & Development Systems, 1981.

Bower, G. H. Mood and memory. *American Psychologist,* 1981, 36, 129–148.

Bronson, G. W. Infants' reactions to unfamiliar persons and novel objects. *Monographs of the Society for Research in Child Development,* 1972, 37, (148).

Brooks-Gunn, J., & Lewis, M. Affective exchanges between normal and handicapped infants and their mothers. In T. Field & A. Fogel (Eds.), *Emotion and interaction : Normal and high risk infants.* Hillsdale, N. J. : Erlbaum, 1982, in press.

Buck, R. Nonverbal behavior and the theory of emotion : The facial feedback hypothesis. *Journal of Personality and Social Psychology,* 1980, 38, 811–824.

Darwin, C. *The expression of emotions in man and animals.* Chicago : University of Chicago Press, 1965 (originally published 1872).

Ekman, P. Universal and cultural differences in facial expression of emotion. In J. R. Cole (Ed.), *Nebraska symposium on motivation, 1971.* Lincoln : University of Nebraska Press, 1972.

Ekman, P. Cross-cultural studies of facial expression. In P. Ekman (Ed.), *Darwin and facial expression : A century of research in review.* New York : Academic Press, 1973.

Ekman, P., Friesen, W. V. & Ellsworth, P. *Emotion in the human face.* New York : Pergamon Press, 1972.

Festinger, L. *A theory of cognitive dissonance.* Stanford : Stanford University Press, 1957.

Freud, S. *The psychopathology of everyday life.* Trans. by A. Tyson. New York : Norton, 1960.

Gunnar, M. R. Control, warning signals and distress in infancy. *Developmental Psychology,* 1980, 16, 281–289.

Hartmann, H. *Ego psychology and the problem of adaptation.* New York : International Press, 1958.

Hebb, D. O. On the nature of fear. *Psychological Review,* 1946, 53, 256–276.

Hebb, D. O. *The organization of behavior.* New York : Wiley, 1949.

Hofsteader, D. *Godel, Escher, Bach : An eternal golden braid.* New York : Random House, 1980.

Hunt, J. McV. *Intelligence and experience.* New York : Ronald Press, 1961.

Izard, C. E. *The face of emotion.* New York : Appleton-Century-Crofts, 1971.

Izard, C. E. *Human emotions.* New York : Plenum, 1977.

Izard, C. E. The Maximally Discriminative Facial Movement Coding System (Max). Newark : Instructional Resources Center, University of Delaware, 1979.

Izard, C. E., & Buechler, S. Emotion expressions and personality integration in infancy. In C. E. Izard (Ed.), *Emotions in personality and psychopathology.* New York : Plenum, 1979.

Izard, C. E., & Dougherty, L. M. Two systems for measuring facial expressions. In C. E. Izard (Ed.), *Measuring emotions in infants and children.* New York : Cambridge University Press, 1982.

James, W. 'What is an emotion?', *Mind,* 1884, 9, 188–205.

James, W. *Principles of psychology.* New York : Henry Holt, 1890.

Kagan, J. Discrepancy, temperament and infant distress. In M. Lewis & L. Rosenblum (Ed.), *The origins of fear.* New York : Wiley, 1974.

Kagan, J. On emotion and its development : A working paper. In M. Lewis & L. Rosenblum (Eds.), *The*

development of affect. New York : Plenum, 1978,.

Laird, J. D. Self-attribution of emotion : The effects of expressive behavior on the quality of emotional experience. *Journal of Personality and Social Psychology,* 1974, 29, 475–486.

Lazarus, R. S. *Psychological stress and the coping process.* New York : McGraw–Hill, 1966.

Lazarus, R. S. Emotions and adaptation : Conceptual and empirical relations. In W. J. Arnold (Ed.), *Nebraska symposium on motivation.* Lincoln : University of Nebraska Press, 1968.

Lazarus, R. S., Averill, J. R., & Optin, E. M., Jr. Towards a cognitive theory of emotion. In M. B. Arnold (Ed.), *Feelings and emotions.* New York : Academic Press, 1970.

Lewis, M. Developmental theories. In I. L. Kutash, L. B. Schlesinger, et al. (Eds.), *Handbook on stress and anxiety.* San Francisco : Jossey–Bass, 1980.

Lewis, M. & Brooks, J. Self, other and fear : Infants' reactions to people. In M. Lewis & L. Rosenblum (Eds), *The origins of fear.* New York : Wiley, 1974.

Lewis, M., & Goldberg, S. Perceptual-cognitive developments in infancy : A generalized expectancy model as a function of mother-infant education. *Merrill–Palmer Quarterly,* 1969, 15, 81–100.

Lewis, M., Goldberg, S., & Campbell, H. A developmental study of information processing in the first three years of life : Response decrement to a redundant signal. *Monographs of the Society for Research in Child Development,* 1969, 34 (9, Serial No.133).

Lewis, M., & Michalson, L. The socialization of emotions. In T. Field & A. Fogel (Eds.), *Emotion and interaction : Normal and high–risk infants.* Hillsdale, N. J. : Erlbaum, 1982.

Lewis, M., & Michalson, L. *Children's emotions and moods : Theory and measurement.* New York : Plenum, 1983.

Mandler, G. *Mind and emotion.* New York : Wiley, 1975.

Mandler, G. The generation of emotion : A psychological theory. In R. Plutchik & H. Kellerman (Eds.), *Emotion : Theory research and experience, Volume 1 : Theories of emotion.* New York : Academic Press, 1980.

McCall, R. B. Smiling and vocalization in infants as indices of perceptual-cognitive processes. *Merrill–Palmer Quarterly,* 1972, 18, 341–347.

Norman, D. A., & Rumelhart, D. F. *Exploration in cognition.* San Francisco : Freeman, 1975.

Piaget, J. *The origin of intelligence in children.* New York : Norton, 1952.

Plutchik, R. A general psychoevolutionary theory of emotion. In R. Plutchik & H. Kellerman (Eds.), *Emotion : Theory, research and experience, Vol. 1 : Theories of emotion.* New York : Academic Press, 1980.

Royce, J. R., & Diamond, S. R. A multifactor-system dynamics theory of emotion : Cognitive-affective interaction. *Motivation and Emotion,* 1980, 4, 263–298.

Schachter, S. The interaction of cognitive and physiological deteminants of emotional state. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 1). New York : Academic Press, 1964.

Schachter, S., & Singer, J. Cognitive, social and physiological determinants of emotional state. *Psychological Review,* 1962, 69, 378–399.

Schaffer, H. R. Cognitive components of infants' response to strangeness. In M. Lewis & L. Rosenblum (Eds.), *The origins of fear.* New York : Wiley, 1974.

Siminov, P. V. The information theory of emotion. In M. B. Arnold (Ed.), *Feelings and emotions.* New York : Academic Press, 1970.

Sokolov, E. N. *Perception and the conditioned reflex.* New York : Macmillan, 1963.

Sullivan, M. W., Rovee–Collier, C. K., & Tynes, D. M. A conditioning analysis of long-term memory in 3-month-old infants. *Child Development,* 1979, 50, 152–162.

Tomas, A., Chess, S., Birch, H. G., Hertzig, M. E., & Korn, S. Behavioral individuality in eary childhood. New York : New York University Press, 1963.

Tomkins, S. *Affect, imagery, consciousness (Vol. 1), The positive affects.* New York : Springer, 1962.

Tomkins, S. *Affect, imagery, consciousness (Vol. 2), The negative affects.* New York : Springer, 1963.

Tomkins, S. S. Affect as the primary motivational system. In M. B. Arnold (Ed.), *Feelings and emotions.* New

York : Academic Press, 1970.

Watson, J. B., & Rayner, R. Conditioned emotional reactions. *Journal of Experimental Psychology*, 1920, 3, 1-14.

Watson, J. S. The development of and generalization of "contingency awareness" in early infancy. *Merrill-Palmer Quarterly*, 1966, 12 123-125.

Watson, J. S. Smilng, cooing and "the game." *Merrill-Palmer Quarterly*, 1972, 18. 323-339.

Zajonc, R. B. Feeling and thinking : Preferences need no inferences. *American Psychologist*, 1980, 35, 151-175.

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INFANT'S TEMPERAMENTAL DISPOSITION, MOTHER'S MODE OF INTERACTION, QUALITY OF ATTACHMENT, AND INFANT'S RECEPTIVITY TO SOCIALIZATION — INTERIM PROGRESS REPORT

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This report will present the results of a longitudinal study of 29 first-born Japanese infants growing up in urban middle-class nuclear families. These infants who have been followed from birth through 23 months of age were observed in a standard Ainsworth strange situation when they were 12 months old. Nineteen infants were coded type B, 10 were coded type C and none were coded type A. Analysis of their behaviors in other situations reveals the following results : 1) During the newborn period significantly more C infants than Bs showed extreme crying to the removal of a nipple and home observations at 1 and 3 month periods revealed significantly more irritability among the Cs than among the Bs. 2) Observation of the infants' behavior to the entry of a stranger and temporary separation from their mothers in the situation at 7 months revealed more signs of behavior of fear on the part of the type C than the type B infants. 3) Analysis of 10 min. mother-infant interaction at 7 months revealed that mothers of C infants interrupted the child's play more often, perhaps because the infants were fearful and not playing well. 4) At both 16 and 20 months B infants exhibited a higher proportion of obedient responses to maternal commands than did C infants. 5) Finally at 23 months more C than B babies showed behavioral signs of fear to the approach of a stranger.

Key words : temperamental disposition, attachment, mother-infant interaction, irritability, obedience.

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The objective of our research is to investigate possible relationships among the several variables of : infant's temperamental disposition, mother's mode of interaction, quality of mother-infant attachment developed, and later affective-behavioral development.

Specific experiences in interacting with the mother during the course of the first year of life are believed to create in the infant special affective and behavioral dispositions which are called the "attachment relation" (Ainsworth, Blehar, Waters and Wall, 1978 ; Bowlby, 1969, 1973, 1980).

A related assumption is that variation in the quality of attachment among one-year-olds may have a considerable influence on the process of the child's socialization (Arend, Gove and Sroufe, 1979 ; Waters, Wippman and Sroufe, 1979).

In addition, the pioneering work by Thomas, Chess and Birch on infant's temperament has led to much research interest in the effect on socialization of this variable as well (Thomas, Chess and Birch, 1968 ; Kagan, Kearsley and Zelazo, 1978). However, few studies on attachment have considered the infant's temperament. Therefore, we believe it necessary to explore temperamental differences among infants and to assess how these might influence maternal behavior, the formation of attachment, and the infant's receptivity to later socialization.

Based on these assumptions, our research investigates : (1) the relation of mother-infant interaction to the infant subsequent attachment to the mother ; (2) the relation between the infant's attachment and his/her receptivity to socialization in the second and third years of life ; (3) the relation between the infant's temperamental characteristic and his/her attachment to the mother, and (4) the relation between the infant's temperament and his/her receptivity to socialization.

Our research has been conducted in Japan where maternal behaviors differ considerably from those found in western countries. Available data imply that Japanese mothers encourage a degree of emotional dependence in their children in contrast to the emphasis on independence normally found in America (Caudill and Weinstein, 1969 ; Azuma, Kashiwagi and Hess, 1981). Secondly, a hypothesis has been proposed by Kagan and his collaborators which states that some infants are temperamentally disposed to be inhibited in times of uncertainty and distress (Kagan, Kearsley and Zelazo, 1978). Moreover, they presented evidence suggesting that children of Chinese descent are more inhibited in unfamiliar situations than are Caucasian children. Since this finding suggests cultural differences, the study of Japanese infants and their mothers should be particularly significant.

Our research developed out of an America-Japan collaborative seminar on social and affective development sponsored by the Social Science Research Council and the Japan Society for the Promotion of Science in 1979 (Kagan and Miyake, co-chairmen). As a result of this seminar, a longitudinal study was started in 1980 involving 26 newborns and their mothers, and has been conducted in close collaboration with Jerome Kagan and Joseph J. Campos.

The sample studied at our research center at Hokkaido University can be described as follows : (1) The infant is firstborn and born at term without serious pre-or perinatal complications ; (2) the mother is at least a high school graduate and not

employed full-time ; (3) the father is engaged in a white collar or professional vocation ; (4) the mother is between 22 and 30 years of age and the father is above 22 years of age, and (5) no other person is living in the home.

The following provides a brief summary of the research results reported in the succeeding sections.

Twenty-nine infants were observed in a standard Ainsworth strange situation when they were 12 months old. Of these infants 21 were followed from birth through 23 months and 8 were followed from 11 months.

On the basis of analysis of videotape recodings, 19 infants were coded type B (securely attached), 10 were coded type C (anxious/resistant) and none type A (anxious/avoidant). Analysis of their behaviors in other situations suggested that there is a strong temperamental variable that is stable and preserved from the newborn period through to 23 months of age and that tends to be associated with the type C infant :

1) Of the newborns, 5 out of 6 Cs versus 7 out of 11 Bs showed much crying in response to removal of a pacifier nipple. Thus, more Cs became upset.

2) Type-C's also appear to be consistently easily irritated when both reaction to interruption of sucking in the newborn period and observation at 1 and 3 months are considered : only 1 of the 12 B's cried often and was easily irritated, compared to 6 out of 7 C's.

3) At 7 months of age, when a stranger entered, 6 out of the 7 C's became fearful versus only 3 out of 8 B's. When the mother left, 6 out of 7 C's became fearful, compared to only 4 out of 8 B's. Regarding heart rate, if we consider fluctuation value, that is, the difference between each episode and baseline, then during the first 20 seconds of the stranger-enter-episode C's showed larger increases in heart rate than B's, 14 versus 7 beats ; i.e. C's showed more signs of being upset. During the first 20 seconds after the mother exited, C's became more anxious : they showed bigger increases in heart rate, 22 versus 6 for B's. At baseline C's showed a heart rate 9 beats higher than that of B's. These results suggest that there is a correspondence between being more fearful and showing a high heart rate at 7 months of age.

4) Ten-minute observations of mother-infant interaction in an unstructured lab situation were conducted at 7 months of age. Analysis of the videotape recordings revealed that mothers of C infants interrupted the child's play more often–perhaps because the children were fearful and not playing well. On the other hand when B and C infants were classified according to level of the fearfulness and frequency of mother's interruptions the results suggested that the mother's interruption apparently produced more fearful C infants than B infants.

5) At 11 months in a 10-minute free-play situation C's were much more likely to stop their play and run to the mother, indicating anxiety in the lab situation, and consequently the duration of play was shorter for C's (5 min. versus 1 min.).

6) At 16 months of age in two 5-minute play sessions the infant's compliance with maternal commands in a problem-solving situation was assessed. In addition, at 20 months infant response to maternal postponement of gratification was observed. At both 16 and 20 months B babies exhibited a higher propotion of obedient responses to maternal commands and maternal postponement of gratification than C babies.

7) Finally, though not reported fully in this report, at 23 months of age observations were made of the infant's reactions to a stranger and to a robot. Of the 10 B's, 4 showed signs of fear to the stranger and only one was inhibited to both. On the other hand, of the 10 C's, 7 showed signs of fear to the stranger and 3 were inhibited to both. Of the C's tested, 7 were female and 3 males, while there were only 4 B females. This may indicate a correlation among being a female, being a C and being fearful and inhibited.

Our data indicate that an infant's temperamental disposition to become irritable and fearful can make an important contribution to quality of attachment classifications. The data suggest that classifications of behavior in the strange situation does not seem to be totally independent of the infant's temperamental tendencies. However it is not yet possible to rule out the likelihood of an interaction between the infant's temperament and the mother's practices.

MEASUREMENT OF ATTACHMENT AT 12 MONTHS*

The purpose of using the orginal Ainsworth strange situation procedure (Ainsworth et al., 1978) in this study of Japanese infants was to examine attachment patterns in Japanese infants and, in addition, to examine the applicability and/or validity of the procedure for the Japanese culture. The strange situation procedure was designed to measure an infant's attachment to the mother among American middle class families ; in that culture "a mother does not hesitate to take her baby into unfamiliar environments, and she may leave her baby for a few minutes either alone or with a stranger" (Ainsworth et al., 1978, p. xiii). In contrast, Japanese mothers maintain closer contact with their infants. Thus we hypothesized that : (1) there would be more B-type infants among Japanese subjects than among U. S. middle class subjects ; (2) the number of C-type infants in our sample would be smaller than that of the U. S. sample ; and (3) we would have very few A-type infants, although in the U. S. usually about 20% of a middle class sample is classified as A-type.

METHOD

Subjects : The sample was composed of 29 12-month-old infants (range 11:17 – 13:11) of both sexes (12 boys and 17 girls) from middle class intact families residing in Sappro. Mothers were full-time and primary caretakers. According to interviews with the mothers, in the course of one month the infants were left alone or with another adult (father or grandmother) a mean of 2.5 times. All infants were attached most strongly to the mother.

Strangers : Two senior female unmarried students majoring in psychology alternately took the role of stranger.

Procedure : The orginal strange situation procedure (see table 1) was used in our

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*Keiko Takahashi was responsible for the analysis and interpretation reported in this section. The author wishes to thank Dr. Giyoo Hatano for his comments on an earlier draft of this section. Helpful suggestions regarding the Strange Situation Procedure from Dr. L. Alan Sroufe and Dr. Mary Main are gratefully acknowledged.

TABLE 1

Summary of episodes of the strange situation

Number of Episode	Persons Present	Duration	Brief Description of Action
1	Mother, baby, & observer	30 secs.	Observer introduces mother and baby to experimental room, then leaves.
2	Mother & baby	3 min.	Mother is nonparticipant while baby explores ; if necessary, play is stimulated after 2 minutes.
3	Stranger, mother, & baby	3 min.	Stranger enters. First minute : Stranger silent. Second minutes : Stranger converses with mother. Third minutes : Stranger approaches baby. After 3 minutes mother leaves unobtruisively.
4	Stranger & baby	3 min. or less[a]	First separation episode. Stranger's behavior is geared to that of baby.
5	Mother & baby	3 min. or more[b]	First reunion episode. Mother greets and/or comforts baby, then tries to settle him again in play. Mother then leaves, saying "bye-bye."
6	Baby alone	3 min. or less[a]	Second separation episode.
7	Stranger & baby	3 min. or less[a]	Continuation of second separation. Stranger enters and gears her behavior to that of baby.
8	Mother & baby	3 min.	Second reunion episode. Mother enters, greets baby, then picks him up. Meanwhile stranger leaves unobtruisively.

Note : [a]Episode is curtailed if the baby is unduly distressed.
[b]Episode is prolonged if more time is required for the baby to become re-involved in play.(Ainsworth et al., 1978)

laboratory as shown in figure 1. Episodes 4, 6 and 7 were curtailed, if distress on separation lasted 2 minutes in maximum. As shown in table 2, it was necessary to shorten the separation time for one child in Episode 4, for 21 children in Episode 6, and for 15 in Episode 7, out of the total of 28 infants. Episode 6 (infant-alone situation) was skipped if the mother was reluctant to leave the room even after 3 extra minutes in Episode 5. Episode 6 was dropped for this reason for only one mother-infant pair, and was also dropped for one female infant who cried throughout Episode 6.

Prior to the experiment, the mother was given instructions about the procedure using a written scenario. The procedure was recorded by three VTR cameras. One trained observer made narrative records of the infant's behavior to the mother and to the stranger from an adjacent observation room.

RESULTS

The infants were classified into A, B, and C attachment categories, based on Ainsworth's original classification. The results of classification are shown in table 3.

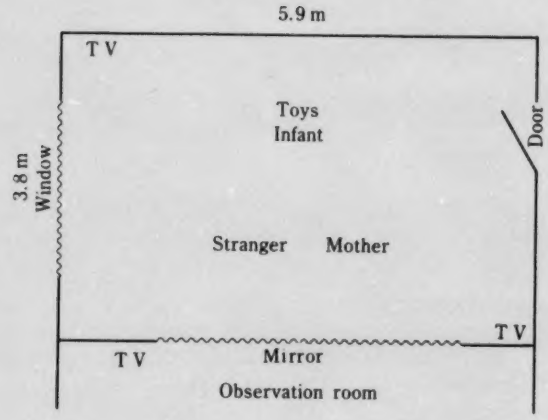

FIGURE 1 Sketch of the physical arrengements of the strange situation.

The following are descriptions of the three classifications used :

A-type, or anxious/avoidant, infants tend to explore without interaction in preseparation episodes, they behave similarly toward the mother and the stranger, upon reunion they actively avert their gaze and avoid or ignore the mother.

B-type, or securely attached, infants explore actively in preseparation episodes, they actively greet and/or seek contact with the mother in reunion episodes and are able to return to exploration in the mother's presence.

C-type, or anxious/resistant, infants are often distressed by the unfamiliar room and the unfamiliar adult, even in the mother's presence. Their exploratory behavior is limited, and they are very distressed by separation. In reunion episodes their proximity and contact-seeking behavior is ineffective ; they are difficult to comfort and often show anger and active resistance to physical contact or interaction.

Contrary to our predictions, in our sample there were fewer infants classified as B-type, but more infants classified as C-type, compared to the Caucasian middle class sample in the U. S. (see table 3). However, as predicted, there were no A-type infants among our subjects.

TABLE 2

Number of infants whose separation time was curtailed

Episode	4	6	7
Male	0	9	7
Female	1	12	8
totals	1	21	15

TABLE 3

Distribution of infants among Sapporo sample

type	B	C	A	totals
Male	9	3	0	12
Female	10	7	0	17
totals	19	10	0	29

DISCUSSION

Why were there so many C-type infants? Does the Japanese culture with its emphasis on caretaking and on the mother-infant bond somehow cultivate an anxious/unstable attachment toward the mother? No conclusions can be formed yet ; however, the following three points may be related to our findings.

1. Is the Ainsworth procedure culture-bound?

The original procedure seemed to arouse more stress among Japanese infants than U. S. middle class infants. The infant-stranger and infant-alone episodes were likely to be more unfamiliar to the Japanese infants since they had less experience in being separated from their mothers compared to the U. S. infants. Examining C-type infants' behavior during the procedure, it was clear that three out of the ten C-type infants behaved like B-type infants from Episode 2 through to Episode 5. But, in Episode 6 (infant alone situation), they were too disturbed to recover from the separation distress even after the mother's return. We have distinguished these infants as 'pseudo-C' type, and, in fact feel that they would be more accurately classified as B-type. The 'pseudo-C' infants were definitely different from C-type infants through Episodes 2 to 5. True C-type infants behaved anxiously throughout the procedure, and hesitated to explore the new environment even with the mother. They preferred to use proximal modes of attachment behaviors (touching, approaching) predominantly directed toward the mother, and refused to interact with the stranger even in the presence of mother.

We assume that in any societies, in which the 'strangeness' of the procedure arouses strong stress, 'pseude-C' infants would be found. These infants would behave like a C-type infants, because of the nature of the experimental procedure, not because of an unstable relationship with the mother.

2. Is the procedure temperament-bound?

In a very stressful situation, temperamental tendencies, such as sensitivity and persistence, will play an important role. For example, a highly sensitive infant, who experiences more stress in the situation, and a persistent infant, for whom recovering from distress is more difficult, will both tend to be classified as C-type infants.

3. Is the duration of distress important?

The duration time of separation distress in Episodes 4, 6, and 7 must affect the infant's classification. As mentioned above, there were many more C-type infants than we had expected among the Japanese sample. Some of them would have been classified as secure B-type infants if the separation had lasted for a shorter period of time.

In Ainsworth's strange situation procedure, infants may be pushed to show attachment behaviors toward the mother by the experimental/artificial stress, induced by the stranger and by being alone. As Japanese infants have rarely been left alone by the mother or cared for by a non-family member, the stress caused by the procedure must be stronger for Japanese infants than for their U. S. counterparts. Therefore, we should perhaps consider a more suitable attachment measurement procedure for Japanese children. For example, we propose a situation in which infants feel comfortable, and in which they have a free option to play with toys or to direct attachment behaviors to the mother.

Though the strange situation procedure seems to be somewhat less valid for Japanese children due to cultural differences in child-rearing patterns, the procedure is still important for cross-cultural comparison. For example, in addition to the classification differences found, the mother's behavior also showed some differences, even though mothers in both countries were instructed in the same way. (e.g. Japanese mothers preferred to use proximal modes to sooth their infants). If we examine carefully the process and results of the procedure, including cultural differences, Ainsworth's measurement of attachment will continue to be useful for cross-cultural studies. Until the cultural variations are more fully understood, however, it will not be possible to clearly interpret the data reported here or other data showing cultural differences (cf., Grossman et. al., 1981, in which 49% of northern German infants were classified as A-type) (see table 4).

TABLE 4

Percentage of B, C, A classifications : Japanese, U.S., and German infants.

Type	B	C	A	
Sapporo	65.5	34.5	0.0	n =29
U.S.	67.4	4.3	28.3	n =46, by Main & Weston
Germany	32.7	12.2	49.0	n =49, by Grossman et al.

ON THE RELATIONSHIP BETWEEN SOME ASPECTS OF INFANT TEMPERAMENT AND ATTACHMENT AT 12 MONTHS*

Infant temperament has received increasing attention from researchers in recent years. Infant temperament can be considered as related to several aspects of early development, one of which is the quality of mother-infant attachment. Within an interactionist point of view, the term "temperament" usually refers not to the inherent characteristics of the infant, but to the caregiver's perception of the infant's characteristics. A main concern of researchers then is to describe how the mother's subjective assessment of the infant's behavioral characteristics is related to the quality of the mother-infant relationship and to the later development of the infant.

Temperament can also be seen as an important basis of what will later be called personality. The present study is concerned with this aspect of temperament and investigated the consistency of particular temperamental characteristics over the first year of life. A now classic study on temperament and its effect in development was carried out by Thomas, Chess, Birch, Hertzig, and Korn (1963). In that study, they correctly pointed out that "the direction of development (of the child) might be considerably influenced by the nature of the child as an organism" (page v). However,

*Shing-Jen Chen was responsible for the analysis and interpretation reported in this section. The author would like to thank the following persons for their cooperation and assistance in the process of carrying out the observations and tests reported in this paper : Dr. Katsuya Uzuki, Dr. Seiichiro Fujimoto. of the Department of Obstetrics, University Hospital, Hokkaido University.

from their pioneering work, there has developed an emphasis on the study of the perceived temperament of the child (through the eyes of the caregiver), a measure which may be insufficient for fully understanding the role of temperament in development (Carey, 1970).

PURPOSES

The objectives of this report were as follows : (1). To explore the possibility of using some objective procedures in assessing infant temperament. (2). To examine the relation between some aspects of infant temperament and the mother-infant relationship.

METHOD

Subjects : Nineteen normal, healthy infants (7 male, 12 female) were followed from birth to 12 months of age. The infant's average birth weight was 2965 g (SD = 360 g), and all Apgar scores at five minutes were above 8. The number of subjects reported here varies from period to period, since not all subjects were successfully tested at each observation.

Procedure : The following procedures were carried out during the newborn period and at one month, three months, seven months and twelve months : (a) Newborn : response to interruption of sucking (RIS). Subjects were allowed to suck a rubber nipple for 20 seconds. After removal of the nipple, the behavior of the infant were recorded on videotape for 60 seconds. Five trials were administered on both the 2nd and 5th (or 6th) days after birth while the infant was still in the hospital. The test was administered in the morning, and an average of 40 minutes after the last feeding, and after the daily bath ; the test was carried out only when the infant was not crying or asleep. After the entire procedure was completed, the videotape was then played back and two research assistants scored the infant's reaction to the removal of the nipple. (b) One month and 3 months : home visit observation. Two research assistants visited the subject's home ; the visit was made in the afternoon around 13:00 for about 2 hours. One of the assistants interviewed the mother, while the second assistant observed the behavior of the infant, and recorded the ongoing behavior every 30 seconds, using a pre-categorized check-list. Special attention was paid to the infant's crying, fussing and thumb-sucking behavior. (c) Seven months : meeting a stranger. The subject was invited to come to the university hospital for a developmental check-up at 7.5 months. Before the check-up, the infant's response to a male stranger was observed. The infant and his/her mother were observed in a series of 8 episodes lasting a total of about 20 minutes. The behavior and facial expression of the infant during these episodes were recorded on videotape. Heart rate was also monitored, and the average HR for every 3 beats was read into one audio input channel of the videotape recorder. A more detailed description of this part of the study is reported in the next section of this report. (d) Twelve months : Ainsworth strange situation. Both the infant and his/her mother were observed in a standard Ainsworth strange situation. (The procedure and results are reported in the preceding section.) The attachment classifications of the infants was used as the measure of the mother-infant relationship.

RESULTS AND DISCUSSION

One of the objectives of this study was to examine the relationship between infant temperament and the quality of the mother-infant relationship. It was hypothesized that there would be some consistency in the temperament evaluation measues carried out during the first year, and also that there would be a relationship found between infant temperament and mother-infant attachment classification. These hypotheses were supported by the results of the study, as follows :

1. Newborn period: RIS. The reaction of the infants to the nipple removal was divided into 5 categories : (1) No response, (2) Searching, (3) Searching and fuss, (4) Searching, fuss and cry, (5) Fuss and/or cry without searching. The first two do not involve obvious affective expression, while affective expression is the most dominant behavior in the last category. The third and the fourth categories exhibit a typical coping style of infants and children, and indeed, adults, in response to milder frustration : that is, problem-solving attempts followed by affective expression when the attempt fails.

Among 11 of the babies classified as B, or securely attached, according to Ainsworth's strange situation classification, four did not show a full cry even once during the two 5-trial sessions, whereas only one out of the six babies classified as C, or insecurely attached, was a non-crying baby.

Three mean reaction times were measured and compared : (1) Latency to obvious response, (2) Latency to full cry, (3) Immediacy of cry (latency to full cry after beginning of obvious response). While the latency to obvious response did not differ very much between B and C babies, C babies showed a longer latency to full cry : they had a longer fussing and/or searching period ; in addition, C babies' full cry was not as immediate as that of the B babies. These results are summarized in table 5.

2. Observation at one and three months : Only 3 out of 12 B babies, but 4 out of 7 C babies showed a large proportion of fussing, crying and thumb-sucking behavior. Combining this result with that of the RIS, 6 out of 7 C babies consistently scored as fussy, with much crying and thumb-sucking from the newborn period to three months. Only one out of 12 B babies was consistently classified in this way (see table 6).

TABLE 5

Results of RIS by attachment classification

Classification in Ainsworth Situation	Number of Non-crying Subjects	Mean RT(sec.) Latency to Respose (SD)	Full-cry (SD)	Immediacy (SD)
B (N=11)	4 (36.3%)	8.7 (5)	16.4 (9)	8.7 (8.9)
C (N=6)	1 (16.6%)	7.26 (4.4)	22.86 (4.06)	17.5 (15.1)

TABLE 6

Consistently irritable infants

Classification in Ainsworth Situation	One & Three Months (fuss, cry & thumb-sucking)	From Newborn Period to Three Months (fuss, cry & thumb-sucking)
B (N=12)	3	1
C (N=7)	4	6

3. Seven months : Meeting a stranger. Although both behavioral and HR data were collected, in this report, only the result of the behavioral data will be described. The behavior during the two most stressful episodes (stranger entry and mother exit) was scored and the fearfulness shown by the infant was rated. As shown in table 7, more C babies than B babies were rated to have shown fearfulness in both situations.

TABLE 7

Fearful infants in strange situation at 7 months

Classification in Ainsworth Situation	Strange Entry			Mother Exit		
	Avoid Str.	App. Str.	Fearful	Avoid Str.	App. Str.	Fearful
B (N=8)	2	2	3	3	3	4
C (N=7)	3	2	6	4	2	6

Note : Str. = stranger, App. = approach

The data reported above suggest that selected measurements of infant temperament show some consistency over the first 7 months, and these measurements in turn are related to the behavior of the infant in the Ainsworth strange situation at 12 months.

The selected procedures used in this study can perhaps best be described as measuring an infant's irritability. Our data suggest that babies who are irritable before 3 months tend to be more fearful at 7 months. Furthermore, infants who are classified as C babies at 12 months tend to be irritable and fearful babies at the earlier ages.

THE RELATIONSHIP BETWEEN INFANT'S TEMPERAMENTAL DISPOSITION AT 7 AND 11 MONTHS AND ATTACHMENT AT 12 MONTHS*

The purpose of this section is to examine the possible relationship between infant temperamental characteristics as observed at 7 and 11 months, and the type of mother-infant attachment, as observed at 12 months.

The relationship of the infant's characteristics during the neonatal period to later attachment has previously been examined by Waters et al. (1980) and Crockenberg (1981). In these two studies, the Brazelton Neonatal Behavioral Assessment Scale (NBAS) was used to measure infants' temperamental characteristics. It was found that those infants later classified as anxious/resistant showed signs of unresponsiveness, motor immaturity, problems with physiological regulation (Waters et al., 1980), and irritability (Crockenberg, 1981) when observed during the neonatal period. Similarly, Scarr & Salapatek (1970), Paradise & Curcio (1974), and Berberian & Snyder (1982) have suggested that temperamentally fussier infants show more fearful reactions to a stranger at 8 and 9 months. However, the time span between the NBAS at 7 or 10 days and the strange situation at 1 year (Waters et al., 1980) is too long for attempting to draw relationships between the two. And there is a problem in the studies by Scarr & Salapatek, Paradise & Curcio, and Berberian & Snyder in that only the Thomas and Chess (Thomas et al., 1963) questionnaire was used for measuring the infant's temperamental characteristics.

In this study, infants' temperamental disposition toward extreme fearfulness or inhibition (Kagan, 1982) was measured at 7 months and 11 months ; thus, observations were carried out over a shorter time period than in the previous studies. Infant disposition was measured by observing the infants' reactions to a stranger and in a laboratory play situation at two different points in time. In addition, heart rate (HR) data were also used for measuring the infants' affective reactions to a stranger at 7 months. A series of studies have suggested that HR response can be very useful in detecting emotional and perceptual reaction in infancy. The following patterns of findings regarding HR change have been reported : Campos (1976) has reported that when the infant seems to be attending to the environment or orienting toward a stimulus, HR decelerates, and when the infant seems to be averting his/her gaze or attempting to avoid a stimulus, HR accelerates. Also, Kagan (1982) has found that infants who show extreme inhibition of fear in strange or unfamiliar situations also show higher and more stable heart rates. Thus, individual differences in HR and HR variability may serve as indicators of a disposition to inhibition in unfamiliar contexts.

METHOD

Subjects : Eighteen infants and their mothers were subjects. All mother-infant pairs were observed at 12 months and classified for the quality of the mother-infant attachment relationship (Ainsworth, et al., 1978). The infants were classified as B : securely attached and C : anxious/resistant attached. Of the infants observed at 7

*Kimiharu Satoh was responsible for the analysis and interpretation reported in this section.

months, 11 were coded type B, and 7 were coded type C. Of the 16 infants observed at 11 months, 10 were coded type B, and 6 were type C. Heart rate data was analyzed for all subjects ; however videotape data at 7 months for 3 subjects was not available ; therefore, the analysis of infants' reactions to the stranger at 7 months was based on a total of 15 subjects.

Procedure : 1."Strange Situation" Observation at 7 Months

Infants were tested in a sparsely furnished room, 4m by 3m. There was about a 10-minute warm-up period during which the procedure was explained to the mother. The infant was seated in a high chair beside the mother, and then the experiment began. The procedure consisted of a series of six episodes presented in the same order for all subjects. A brief summary of the procedure is presented in table 8. After the baseline session a male adult stranger entered the room and approached the infant, speaking to infant, touching the infant, and shaking its hand. These same behaviors were continued as the mother left the room and then again entered the room (Episodes 3, 4), and were also repeated when the stranger entered for the second time (Episode 6). Each strange situation was videotaped and all ratings of the infant's reactions were carried out using these videotaped records. The infant's behaviors in reaction to the stranger were coded for : avoidance behavior, approach behavior, negative vocalization (e.g., fussing), crying, and inhibited behavior (e.g., stopping playing when the stranger enters). In addition, continuous heart rate were gathered during the entire session.

TABLE 8

Summary of strange situation procedure (7 months)

Episode	Persons* Present	Time(Min.)
1. Baseline	M, I	3
2. Stranger-Enter Ⅰ	M, I, S	2
3. Mother-Exit	I, S	2
4. Mother-Reunion	M, I, S	2
5. Stranger-Exit	M, I	2
6. Stranger-Enter Ⅱ	M, I, S	2

Note : M=Mother, I=Infant, S=Stranger

2.Free Play Session at 11 Months

The baby and the mother went to the same play room that had been used for the observation of the mother-infant interaction at 7 months and the infant's play behavior was observed for ten minutes. The infant was given many toys and asked to play with them alone at the center of the room. The mother sat in one corner of the room with a female experimenter, and conversed with the experimenter. She was instructed not to interact with her baby unless necessary during the 10 minute session. The infant's activity with the toys was videotaped and the later coding was based on these records. The major variables coded were : number of toys used, varieties of manipulation per one minute, mean duration of play with one toy, number of times the infant broke off a play activity to run to the mother, and mean duration of continued play (without

running to the mother).

RESULTS AND DISCUSSION

1. "Strange situation" observation at 7 months

Results of stranger reaction ratings in Episodes 2 and 3, as the stranger entered and the mother exited, are shown in tables 9a and 9b. When the stranger entered and approached the infant, 6 out of the 7 C-type babies showed fearful or inhibited reactions, and 3 babies tried to avoid the stranger. In contrast, only 3 out of 8 B-type infants showed such fearful behavior. When the mother left the room, 6 out of 7 Cs became fearful, compared to only 4 out of 8 Bs. These results suggest that C babies as a whole tend to be more anxious and inhibited in a stressful situation compared to B babies.

Table 10 presents B and C babies' mean HR (Beats Per Minute) for 20-second periods. C babies showed a higher and more stable HR than B babies through each of the first three experimental episodes. During the first 20 seconds at baseline, for example, C infants' HR was higher than B infants' HR by about 10 points, and C

TABLE 9(a)

Infant behavior in strange situation at 7 months by attachment classification (Ⅰ)

	Stranger–Entry							
ATTACHMENT TYPE	Avoid		Approach		Negative Vocal.		Inhibited	
B-Type	2/8	25%	2/8	25%	4/8	50%	3/8	37.5%
C-Type	3/7	42.9%	2/7	28.6%	2/7	28.6%	6/7	87.5%

TABLE 9(b)

Infant behavior in strange situation at 7 months by attachment classification (Ⅱ)

	Mother–Exit									
ATTACHMENT TYPE	Avoid		Approach		Negative Vocal.		Cry		Inhibited	
B-Type	3/8	37.5%	3/8	37.5%	5/8	62.5%	4/8	50%	4/8	50%
C-Type	4/7	57%	2/7	28.6%	3/7	42.9%	4/7	57.1%	6/7	85.7%

TABLE 10

B- and C-type babies' mean HR(BPM) in strange situation at 7 months

EPISODE	B-type(n=11)	C-type(n=7)
Baseline(first 20 sec.)	141.9	152.2
Stranger-Enter(first 20 sec.)	143.5	150.9
Mother-Exit(first 20 sec.)	141.9	146.0
Mother-Exit(last 20 sec.)	157.4	171.2

Note : Data shown are based on the average HR of B- and C-type babies at each episode.

infants' mean SD of HR was 9.3 in contrast to a mean SD of 12.9 for B infants. Differences in heart rate between each episode and baseline are shown in table 11. It was expected that C's, who tended to be more fearful in reaction to the stranger, would show HR acceleration during the stranger-entry episode, based on the results of the study by Provost & Gouin Décarie (1974). In that study, infants who were rated as reacting positively to a stranger showed large and statistically significant HR decelerations to the approach of the stranger ; and, in contrast, infants rated as reaching negatively showed steady HR increases during the stranger's approach. As shown in table 11, however, HR acceleration at the stranger's entrance was not found for the C infants, although C infants exhibited more fearful or inhibited reactions. This is a puzzling finding for which we are not able to offer any explanation. However, the expected pattern of difference did occur in the last 20 seconds of the mother-exit session, which was possibly the most stressful episode : C infants showed a higher HR 171.2 BPM compared to 154.4 BPM for the B infants. These HR's represented an increase of 20.5 BPM for C's versus 12.6 for B's.

TABLE 11

B- and C-type babies' HR changes at stranger-entry and mother-exit session

ATTACHMENT TYPE	Stranger-Entry (first 20 sec.)	Mother-Exit (first 20 sec.)	Mother-Exit (last 20 sec.)
B-type	+ 3.54	+ 0.77	+12.61
C-type	− 1.29	− 4.67	+20.56

Note : HR change was obtained by subtracting mean HR at baseline(20 sec.) from mean HR at stranger-entry(20 sec.)/mother-exit(20 sec.) for each subject. Mean HR change is the average for each group.

Summarizing the findings at 7 months, C infants showed both higher HR and, as described above, more fearful or inhibited behaviors in the strange situation than did B infants. These results therefore support Kagan's hypothesis that heart rate may indicate differences in temperamental characteristics. The results also suggest that there are differences between B and C-type infants in their reactions to relatively stressful situations that may be related to temperamental characteristics.

2. Free play observation at 11 months

Results of the analysis of the infant's play activities are presented in table 12. There were no differences between B's and C's in the number of toys used, and varieties of manipulation per one minute. However, it was found that C's were much more likely to stop their play activity and run to the mother than were B infants (5.5 times versus 1.9). Consequently, the mean duration of play activity was shorter for C's, 5 minutes versus 1 minute. These results thus again indicate that C's, as opposed to B's tended to be more fearful or anxious in the laboratory situation.

CONCLUSION

The purpose of this study was to examine the possible relationship between the infant's temperamental disposition or behavioral characteristics and the mother-infant

TABLE 12

B- and C-type babies' behaviors in free play session at 11 months

	B-type (n=10)	C-type (n=6)
Number of toys used	8.80	8.83
	(2.86)	(2.34)
Varieties of manipulation per 1 min.	9.44	9.89
	(1.88)	(2.81)
Mean duration of manipulation per 1 toy	18.90 sec.	13.45 sec.
	(14.18)	(4.71)
Number of times leaves play activity	1.90	5.50
	(1.58)	(2.81)
Mean duration of play activity(min.)	5.0 min.	1.0 min.

attachment bonding.

Infants classified at 12 months as insecurely attached or anxious/resistant were generally more fearful or inhibited in reaction to a stranger at 7 months, and tended to be more anxious in a free play session at 11 months.

These results imply that a young infant's temperamental characteristics may make an important contribution toward the later development of the mother-infant attachment relationship.

THE RELATIONSHIP BETWEEN MOTHER-INFANT INTERACTION AT 7 MONTHS AND ATTACHMENT AT 12 MONTHS *

The purpose of this section was to examine the relationship between characteristics of mother-infant interaction at 7 months and attachment at 12 months. For this purpose, securely and insecurely attached pairs were compared for the quality of interaction.

According to Ainsworth, Blehar, Waters and Wall (1978), the mother's sensitivity and responsivity in the child's early years is related to the type of attachment developed. It was proposed here that when a mother is sensitive and responsive to her infant, then a more interactive or "meshed" type of relationship would be developed. Thus, it was expected in this study that those pairs who had established more meshed relationships would develop a more secure type of attachment. The following three aspects of interaction were used as indices of a meshed relationship ; (1) effectiveness of mother's stimulation ; (2) mother's responsiveness ; (3) extent to which the mother respects the infant's intention and need.

*Tatsuo Ujiie was responsible for the analysis and interpretation reported in this section.

METHOD

Subjects : 19 first-born infants (6 males and 13 females) and their mothers were subjects. All infants were 7 months of age at the beginning of the study.

Procedure : 1. Mother-infant interaction—We recorded and analyzed 10-min mother-infant interaction sessions carried out in an unstructured laboratory situation at 7 months. The categories of behavior observed were as follows : mother's stimulation, mother's response, mother's interruption of infant's behaviors and soothing. The category of mother's stimulation was divided into two subcategories : (a) effective stimulation–stimulation which was successful in eliciting behavior from the infant ; i. e., this category represented a combined measure of the mother's stimulation plus the infant's responsivity to stimulation ; (b) responsive stimulation—stimulation which followed infant behaviors.

2. Type of attachment—Type of attachment was measured at 12 months. The attachment classifications were carried out using Ainsworth's classification.

RESULTS AND DISCUSSION.

To test the relationship between mother-infant interaction and type of attachment, securely attached (B classification) and insecurely attached (C classification) pairs were compared for the frequency of occurrence of each category of maternal behavior. The results showed that all B and C mothers stimulated their infants about equally as often, and all infants, regardless of type of attachment, responded to their mothers' stimulations relatively well. However, B mothers were more responsive to their infants' ongoing behaviors than were C mothers. Therefore, at 7 months, B mother-infant pairs were more interactive than C pairs. However, the level of responsive stimulation alone cannot predict the type of attachment (see table 14), and other

TABLE 13

Frequency of each category of interaction

	Stimulation*	Effective** stimulation	Responsive** stimulation	Interruption
B	438	307	238	26
N 12	(48.9%)	(70.1%)	(54.3%)	$\bar{x}$ = 2.25(SD 2.83)
C	303	200	133	45
N 7	(51.3%)	(66.0%)	(43.9%)	$\bar{x}$ = 6.43(SD 2.64)

Note ; * The numbers in parentheses represent percentages of the total maternal behaviors.
** The numbers in parentheses represent percentages of maternal behaviors directed toward stimulating the infant.

factors must also be considered. For example, in the results, it was also found that C mothers more than B mothers interrupted their infants' ongoing behavior quite often. A frequency interrupt or not interrupt can perhaps be interpreted as a measure of the degree to which the mother respects or is sensitive to the infant's intention and need. If so, then the results may be taken as indicating differences between B and C mothers

TABLE 14

Infants classified by level of responsive stimulation and attachment category

	B	C
High	7	10
Low	5	9

TABLE 15

Infants classified by level of interruption and attachment classification

	B	C
High	3	6
Low	9	1

in their level of sensitivity. As shown in table 15, the level of the mother's interruption of the infant's behaviors at 7 months was predictive of the later type of attachment, $x^2 = 6.54$, $p < .05$. However, three mother-infant pairs developed a secure type of attachment despite the mothers' higher level of interruption. And, of the mothers who interrupted only infrequently, one mother-infant pair developed an insecure type of attachment. Why ? One possible interpretation is that the infants' temperamental characteristics played an intermediate role between the mother's sensitivity and the type of attachment developed. To test this possibility, the attachment categories were broken down by the level of infant inhibition (see pp. 1–14 in this report.) and the level of mother's interruption (table 16). Thus, table 16 indicates that the effect of the mother's interruption differs according to the level of the infant's inhibition. Uninhibited infants will apparently develop a secure attachment regardless of their mothers' characteris-

TABLE 16

Relationship among level of interruption, infant's inhibition and attachment

	B		C	
	Inhibited	Uninhibited	Inhibited	Uninhibited
Interruptive	0	3	5	1
Non-interruptive	2	4	1	0

tics. On the other hand, inhibited infants are more influenced by the characteristics of their mothers' behavior. That is, if a mother interrupts her infant's behavior frequently, the infant will develop an insecure attachment : and if mother does not tend to interrupt the infant's behavior, then the infant will develop a secure attachment.

These results suggest that there is a significant role played by the infant's characteristics, such as temperament, in the development of attachment. Due to the small size of our sample, this conclusion can be only tentative. Nevertheless the results are enough to suggest the necessity of further research concerning the role of the infant in the development of mother-infant relationships such as attachment.

QUALITY OF ATTACHMENT AND COMPLIANCE IN THE SECOND YEAR *

Ainsworth et al. (1978) reviewed data indicating that infants who are classified as securely attached (B-type attachment) at one year of age later exhibit higher levels of

socio-emotional behavior and cognitive performance compared to insecurely attached infants, both A-type (anxious/avoidant) and C-type (anxious/resistant). They concluded that secure attachment to the mother is an important indicator of later successful adaptation. They also suggested that part of the reason for this better adaptation of B-type infants is their greater receptivity to their mothers' early intervention efforts compared to that of A- and C-type infants. In fact, several studies have found that children who are classified as securely attached to their mothers are significantly more obedient to maternal commands or prohibitions in the second year of life than are insecurely attached children (Londervill & Main, 1981 ; Matas et al., 1978).

The purpose of this section is to examine whether this relationship between quality of attachment and later obedience/compliance holds true for Japanese children. The fact that differences in the proportions of A-, B- and C-type infants have been found for Japanese vs. U. S. samples (see pp. 1–8 in this report) indicates that some differences might be expected regarding this relationship as well.

Specifically, three questions were adressed in this study : (a) For Japanese subjects, do securely attached children exhibit more compliance with maternal commands than do insecurely attached children ? (b) Is there any developmental change in the relationship between security of attachment and compliance between 16 months of age and 20 months of age ? (c) Do differences occur in the attachment-compliance relationship depending on the type of compliance situation tested ?

METHOD

Subjects : The sample consisted of 29 middle-class mothers and their first-born infants who were followed from 11 months or earlier to 20 months of age. Seventeen B-type infants (7 male, 10 female) and 10 C-type infants (3 male, 7 female) were observed at 16 months of age and 13 B-type infants (5 male, 8 female) and 8 C-type (1 male, 7 female) were observed at 20 months of age.

Procedure : 1. Compliance with maternal commands in a problem-solving situation at 16 months of age

Infants were observed for two 5-minute play sessions after an initial, introductory play session of at least 5 minutes. Two toys were presented to the infant : a block game and a "magic board". The block game consisted of 18 blocks of different shapes which could be fitted into a box with correspondingly shaped holes. The magic board was a board on which infants could draw pictures with a special pencil and then erase them by sliding a special button. The toys were selected to be too difficult for the infants to play with by themselves and so they required that the infant obtain the monther's assistance.

The mother was instructed in how to play with the toys before the session, and then was asked to show her infant how to play with these toys at the beginning of each five minute play session. The mother sat next to the infant while she explained the use of the toys, and then left the infant with the toys and moved to a seat two meters away. The entire procedure was recorded on videotape. Mother-infant interaction

* Nobumoto Tajima was responsible for the analysis and interpretation reported in this section.

during the infants' play with the toys was initiated only by the infant's, request for help from the mother.

The number of maternal commands and the number of infant responses to these maternal commands were tabulated. The infant responses were coded as exhibiting obedience, active disobedience or passive disobedience. A behavior was coded as "obedience" if the infant either obeyed or attempted to obey the mother's request/command. A behavior was coded as "active disobedience" if the infant did not comply with the mother's instruction but, rather, did something else and/or responded with negative vocalization ; and as "passive disobedience" if the infant simply did not respond to the maternal command.

2. Infant response to maternal postponement of gralification at 20 months of age

Each infant was observed in a situation where, seated on a high chair with a restraining belt, he/she could play with one pair of toys (a cup and a plate) placed on the table attached to the high chair. However, a much more interesting set of toys (including dolls, cars, books etc.) was also presented, but on the floor out of the infant's reach. The infant therefore had to depend on the mother's help in order to play with these toys. The mother was again seated two meters from the infant and was asked to fillout some questionnaires. She was instructed not to comply with the infant's demand for the toy on the floor until she had completed the questionnaires.

The number of demands/requests made by the infants, the mothers' responses (e.g. commands, prohibitions) and the infants' responses to the maternal failure to immediately comply with the request (postponement of gratification) were tabulated. The infants' responses were coded according to the same categories as were used for the 16-month assessment.

RESULTS

1. Compliance with maternal commands in the problem-solving situation

Table 17 shows the means for maternal commands, and for infant obedient and infant disobedient responses in the play sessions ; the results of t-tests comparing these means by quality of attachment groups are also presented in table 17. The means in table 17 represent means per minute since the duration of the play session varied among subjects, depending on the length of time that the mother spent explaining the

TABLE 17

Means for maternal and infant variables and t-test by attachment type in the problem-solving situation

	Attachment classification at 12 months					
	Secure(N=17)		Insecure(N=10)		t-test	
	M	SD	M	SD	t	P
Maternal commands	1.65	0.84	1.74	1.20	−.21	n.s.
Infant obedient response	0.84	0.62	0.59	0.34	1.12	n.s.
Infant disobedient response	0.82	0.60	1.15	1.02	−1.02	n.s.

Note ; Means are mean number of behaviors per minute.

toys to the infant. As the number of passive disobedient behaviors was small, these were combined with active disobedient behaviors for one general category of disobedience.

As shown in table 17, no difference was found between B- and C-type infants in the number of maternal commands or prohibitions, $t = -.21$, $df = 25$, *n.s.*. Also, no significant differences occured between two attachment groups for obedient or disobedient responses, $t = 1.12$, $df = 25$, *n.s.* ; $t = -1.02$, $df = 25$, *n.s.* respectively, (although B-type infants tended to comply with maternal commands more than did C-type infants).

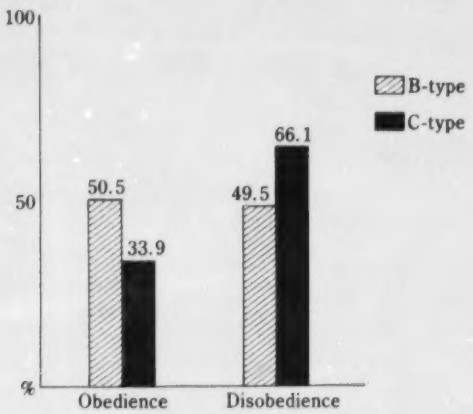

FIGURE 2 Proportion of obedience-disobedience by attachment type in the problem-solving situation

However, as indicated in figure 2, the proportion of obedient responses relative to disobedient responses was significantly higher for B-type infants than for C-type infants, $x^2 = 12.04$, $df = 1$, $p < .005$. Thus, these data indicate that securely attached infants exhibited more compliance with maternal commands than did insecure infants.

2. Compliance with maternal postponement of gratification

Table 18 presents the mean number of infant demands/requests, of maternal responses/commands, and of infant's obedient and disobedient responses to the mother's failure to fulfill the request ; results of t-tests comparing these means for the two attachment groups are also shown. Again, the means are defined per minute, since the play session duration varied over the mother-infant pairs. As in the previous (16-months) experiment, active and passive disobedience were combined into a general disobedience category, due to the small number of passive disobedience responses.

No significant differences were found between the two attachment groups for the number of infant requests/demands, $t = -.030$, $df = 19$, *n.s.*, the number of maternal responses/commands, $t = -.206$, $df = 19$, *n.s.*, or for infant's obedient and disobedient responses, $t = .765$, $df = 19$, *n.s.* ; $t = .492$ $df = 19$, *n.s.* respectively.

There was, however, a significant difference found for B-type versus C-type

TABLE 18

Means for maternal and infant variables and t-test by attachment type in the postponement situation

	Attachment classification at 12 months					
	Secure(N=13)		Insecure(N=8)		t-test	
	M	SD	M	SD	t	p
Infant requests / demands	0.68	0.29	0.68	0.40	−.030	n.s.
Maternal requests / commands	1.13	0.64	1.20	0.68	−.206	n.s.
Infant obedient response	0.54	0.35	0.41	0.38	.765	n.s.
Infant disobedient response	0.59	0.47	0.79	0.54	−.492	n.s.

Note ; Means represent mean behaviors per minute.

infants in the proportion of obedient responses, $x^2 = 4.42$, $df = 1$, $p < .05$ (see figure 3), indicating again, as in the problem-solving situation, that the more securely attached infants tended to exhibit more compliance to maternal commands.

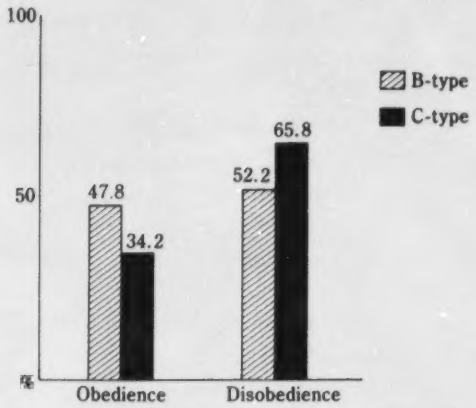

FIGURE 3 Proportion of obedience-disobedience by attachment type in the postponement situation

DISCUSSION

We have found that infants who are securely attached to their mother exhibit a higher proportion of obedient responses to maternal commands than do insecurely attached infants at both different ages (16 months and 20 months of age), and in different situations (problem-solving and postponement situation). Although this finding seems to be generally consistent with the findings of some U. S. studies (Londervill & Main, 1981; Matas et al., 1978), there also appears to be some cross-cultural difference in the results. For example, while for our B-type infants there was no difference in the proportion of obedient-disobedient responses over the two situations, some U. S. studies have indicated that B-type infants are less obedient to maternal commands in a "clean-up toys" situation than in a problem-solving situation (Matas et al., 1978). We

will have to examine this type of difference further in order to determine whether it represents a consistent cross-cultural difference. If found, it might indicate some cross-cultural variation in the mechanisms mediating the relationship between secure attachment and compliance.

In addition, before concluding that the same mechanisms underlie the relationship between quality of attachment and receptivity to socialization, there are other problems that should first be investigated. These concern the content of the mother's commands, the infant's temperamental characteristics, and developmental change in level of competence.

1. Relationship between the content of maternal commands and infant compliance

In this study the content of the requests/commands given by the mothers to their infants was not analyzed. However, it is possible that an infant's compliance may depend on the kind of commands given. For example, in the postponement situation, most mothers typically gave their infants a response such as : "Wait a minute, please. I'll be finished soon, and then I'll do it for you". However, some mothers of B-type infants gave responses which temporarily resolved their infants' frustration. One such mother, whose infant made the most requests/demands for the better toys (1.5 times/min.), could elicit an obedient response from her infant by giving him suggestions regarding the available toys (the cup and plate) such as "How about drinking milk from the cup?", and "Then, wash your cup, please".

Such variation in the nature of the mother's response strategy may be an important variable in determining the infant's compliance or noncompliance. Further research should be directed toward examining this aspect of a compliance situation as well.

2. The relationship between infant temperamental characteristics and compliance

An infant's response to maternal directions could also be affected by the infant's perception of the given situation. The infant's perception of the situation would in turn be at least partially related to his/her general temperamental characteristics, such as inhibition (Kagan, 1982) or fearfulness. In our study, for example, one infant throughout the experiment showed fearfulness, begging his mother to take him away from the situation, and consistently rejected his mother's commands. (This case was dropped from the analysis.)

Though this certainly represents a very extreme case, it does point up the fact that there are individual differeces in perception of a situation. These differences are most likely related to temperamental characteristics, and should also be taken into account when considering an infant's response to maternal commands.

3. Developmental change in level of compliance

As an infant gains in competence, he/she will begin to become more independent, particularly in those situations which the infant is able to handle without the mother's assistance (Londervill & Main, 1981). This developmental aspect should be taken into account in attempting to define the relationship between quality of attachment and

compliance. That is, the proportion of obedient behavior might be expected to vary with the type of situation, and with the infant's level of competence (which could also be related to developmental level). With an increase in competence and control over his/her environment, the infant may begin to display more willfulness, reflecting a developing sense of self. Such willfulness may produce more disobedience, yet the increased disobedience might reflect an adaptive phase and represent a necessary step in the child's development.

In conclusion, examination of such additional variables as these may lead toward greater understanding of the factors underlying the relationship found between quality of attachment and compliance.

REFERENCES

Ainsworth, M. D. S., Blehar, M. C., Waters, E. & Wall, S. *Patterns of attachment : A psychological study of the strange situation.* N. J. Lawrence Erlbaum Associates, 1978.

Arend, R., Gove, F. L., Sroufe, L. A. Continuity of individual adaptation from infancy to kindergarten. *Child Development*, 1979, 50, 950–959.

Azuma, H., Kashiwagi, K & Hess, R. D. *The influence of maternal teaching style upon the cognitive development of children.* Tokyo : The University of Tokyo Press, 1981 (In Japanese).

Berberian, K. E. & Snyder, S. S. The relationship of temperament and stranger reaction for younger and older infants. *Merrill-Palmer Quarterly*, 1982, 28, 79–94.

Bowlby, J. Attachment. *Attachment and loss.* Vol. Ⅰ. New York : Basic Books, 1969.

Bowlby, J. Separation, anxiety and anger. *Attachment and loss.* Vol. Ⅱ. New York : Basic Books, 1973.

Bowlby, J. Loss. *Attachment and loss.* Vol. Ⅲ. New York : Basic Books, 1980.

Campos, J. J. Heart Rate : A sensitive tool for the study of emotional development in the infant. In L. P. Lipsitt (Ed.) *Developmental psychobiology.* N. J. : LEA, 1976, 1–31.

Carey, W. B. A simplified method of measuring infant temperament. *Journal of Pediatrics*, 1970, 77, 188–194.

Caudill, W. & Weinstein, H. Maternal care and infant behavior in Japan and America. *Psychiatry*, 1969, 32, 12–43.

Crockenberg, S. B. Infant irritability, mother responsiveness, and social support influences on the security of infant-mother attachment. *Child Development*, 1981, 52, 857–865.

Grossman, K. E., Grossman, K., Huber, F. & Wartner, U. German children's behavior towards their mothers at 12 months and their fathers at 18 months in Ainsworth's strange situation. *International Journal of Behavioral Development*, 1981, 4, 157–181.

Kagan, J., Kearsley, R. B. & Zelazo, P. R. *Infancy : Its place in human development.* Cambridge : Harvard University Press, 1978.

Kagan, J. Heart rate and heart rate variability as signs of a temperamental dimension in infants. In C. E. Izard (Ed.) *Measuring emotions in infants and children.* Cambridge University Press, 1982, 38–67.

Londervill, S. & Main, M. : Security of attachment, compliance, and maternal training methods in the second year of life. *Developmental Psychology*, 1981, 17, 3, 289–299.

Main, M. & Weston, D. R. The quality of the toddler's relationship to mother and to father : related to conflict behavior and the readiness to establish new relationships. *Child Development*, 1981, 52, 932–940.

Matas. L., Arend, R. A. & Sroufe, L. A. : Continuity of adaptation in the second year: The relation between quality of attachment and later competence. *Child Development*, 1978, 49, 547–556.

Paradise, E. B. & Curcio, F. Relationship of cognitive and affective behaviors to fear of strangers in male infants. *Developmental Psychology*, 1974, 10, 476–483.

Provost, M. & Gouin Décarie, T. Modifications du rhythme cardiaque chez des enfants de 9–12 mois au cours de la recontre avec la personne étrangère, cited in Campos, J. J. Heart Rate : A sensitive tool for the

study of emotional development in the infant. In L. P. Lipsitt (Ed.) *Developmental Psychobiology*. N. J. : LEA 1976. p.22.

Scarr, S. & Salapatek, P. Patterns of fear development during infancy. *Merrill-Palmer Quarterly*, 1970, 16, 53–90.

Thomas, A., Chess, S., Birch, H. G., Hertzig, M. E. & Korn, S. *Behavioral individuality in early childhood*. New York : New York University Press, 1963.

Thomas, A., Chess, S., & Birch. H. G. *Temperament and behavior disorders in children*. New York : New York University Press, 1968.

Vaughn. B., Egeland, B. & Sroufe, L. A. Individual differences in infant-mother attachment at twelve and eighteen months : Stability and change in families under stress. *Child Development*, 1979, 50, 971–975.

Waters, E., Wippman, J. and Sroufe, L. A. Attachment, positive affect and competence in the peer group. *Child Development*, 1979, 50, 821–829.

Waters, E., Vaughn, B. E. & Egeland, B. R. Individual differences in infant-mother attachment relationship at age one : Antecedents in neonatal behavior in an urban, economically disadvantaged sample. *Child Development*, 1980, 51, 208–216.

COLLECTIVE SCIENTIFIC DISCOVERY BY YOUNG CHILDREN

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This paper proposes a conceptual model of the processes by which children acquire knowledge through their interaction with peers in dialy life situations. It explains this model through a demonstration case involving the acquisition of "folklore" knowledge regarding the making of ice. The proposed model is different from the Vygotskian vertical interaction model in that it assumes that the member who is most capable in a group can change from moment to moment during the processes of knowledge acquisition. Furthermore, the model differs from the Piagetian horizontal interaction model in that it takes into account the adult's roles in setting up the situation and in temporarily acting as a more capable peer. According to the model, the processes of knowledge acquisition through peer interaction consist of cycles of four stages : 1) the initiation of information seeking, 2) the production of a number of hypotheses, often implicit, 3)the informal experimentation, and 4) the collection of data and induction.

Key words : Knowledge acquisition, Peer interaction, Piaget, Vygotsky.

This paper present a conceptual model of the processes through which children acquire knowledge in intreaction with peers in daily life situations.

It is well known that social interaction plays an important role in the acquisition of knowledge of the physical world. There are two distinguishable types of social interaction. One is vertical, represented by adult-child interaction, and the other is horizontal, as in peer interaction. Vygotsky (1978) emphasized the importance of vertical interaction. He pointed out that a child could do more than what he/she could do alone "under adult guidance or in collaboration with more capable peers" (p.87). His model originally concerned the levels of performance and/or problem solving strategies on intelligence test items. However, if we regard the acquisition of knowledge as a sort of "open problem solving", this model can directly be applied with the depth of acquired knowledge replacing the level of performance. This applied model of knowledge acquisition through vertical interaction does not necessarily emphasize the role of direct instruction by a teacher, as it has often been interpreted in connection with Vygotsky's discussion on "scientific concepts" (as against "spontaneous concepts"). Such an interpretation is too narrow for his general concept of "from interpersonal to intrapersonal". Rather, his assertion should be interpreted as suggesting that the development proceeds through the following processes : At the beginning, an individual can take care of a part of the problem to be solved, and then gradually comes to take on responsibility

for the whole by himself/herself. In these processes it is the more capable member of the society that takes charge of those parts which the beginner cannot handle. The Vygotskian model seems to have assumed that one member (i. e., the developed person) continues to be more capable than the other (the developing individual) at every moment in all the phases of problem solving. Considering that even adults can sometimes be helped by, and learn from, children in interaction, it is not reasonable to assume that which member is more capable is fixed throughout problem solving processes. We need a more dynamic process model which can take into account that which member is more capable can change from moment to moment in the processes of problem solving (or knowledge acquisition). We will describe this point below in more detail.

In contrast to Vygotsky, Piaget claimed that the horizontal interaction was important in the acquisition of knowledge in educational settings (Piaget, 1969 ; Duckworth, 1964). He did not specify the processes of knowledge acquisition through this interaction nor the nature of knowledge acquired thereby. Piaget himself was primarily interested in demonstrating that the structures of intellectual operations were identical to the structures underlying social interactions (Piaget, 1965). However, recent Piaget inspired studies have demonstrated that knowledge can be acquired through peer interaction (e. g., Murray, 1972 ; Miller & Brownell, 1975 ; Doise et al., 1974 ; Perret-Clermont, 1980). The tasks used in these studies were primarily the conservations of weight, length, quantities of liquid, or number (Murray, 1972 ; Miller & Brownell, 1975 ; Perret-Clermont, 1980), and copying geometric figures (Perret-Clermont, 1980) ; the knowledge to be acquired was a sort of procedural decision rule. Children in groups of two (or three), consisting of a conserver or superior and a nonconserver or inferior, were required to deal with a given task in collaboration, and their performances on the posttest were compared with the performances of children who had been required to carry out the same task alone. These studies have found that peer interaction facilitated congnitive structuring not only for inferior children but also for superior ones. It should be noted that this was achieved without an adult's direct instruction or external reinforcement. According to the authors of these studies, this is because the awareness of the presence, and thus an attempt of integration, of different points of view were more likely to occur in peer interaction than individual problem solving.

This experimental Piagetian model for knowledge acquisition has at least two difficulties. First, it unreasonably neglects the role of feedback from the external world, i. e., through "epistemic observation" or "active experimentation", in the acquisition of knowledge. In the Piagetian studies described above, children were not usually permitted to do any experiments in order to examine their conflicting ideas. All that they were allowed was to exchange their opinions.* It is not realistic to think that knowledge is usually acquired through equilibration, without external feedback. The second

*In a study on the conservation of quantities of liquid by Perret-Clermont (1980), children were permitted to use a glass as a sort of measure, if they would like to. However, Perret-Clermont did not comment on the importance of this aspect.

difficulty of the Piagetian model is to ignore the role of the adults who set up the situations for children's problem solving/knowledge acquisition. Even in the experimental peer interaction situations described above, an adult (experimenter) played an important role in the sense that she directed the children to begin the work in collaboration. In daily life situations apparently spontaneous peer interaction is in fact likely to proceed under the indirect influence of adults. Therefore, an adequate model of knowledge acquisition through peer interaction should take into account the adult's role as well. We would like to propose a model eliminating these difficulties.

The Model

We assume that younger children can acquire knowledge without adult's direct teaching, by their collective enterprise in a group whose members share an interest in a certain topic. Unlike adults or older children, they cannot readily acquire knowledge when they individually attempt to do so. In other words, we regard a group whose members share an interest as a system for knowledge acquisition. Each child does not have cognitive ability enough to acquire the target knowledge by himself/herself, but he/she can contribute to the system by saying things about the topic, by informal experimentation from his/her point of view, etc. Consequently, knowledge acquisition can adaptively be achieved by the whole system. In this system who contributes more tends to change from moment to moment in the inquiry processes. That is, the order of "capability" is not fixed as it is in Vygotsky's "vertical" interaction.

In our system an adult may function in two ways. First, the adult sets up situations where children are able to be engaged in their inquiry in a group. He/She provides them with equipment and/or materials to manipulate, explore, etc. He/She also sees to it that children interact with one another smoothly without much quarreling. Secondly, he/she may sometimes take a role of a "more capable peer" in an attempt for knowledge acquisition. When peer interaction comes to a deadlock in the inquiry process, i. e., when none of the children can achieve a breakthrough any more, the adult can take over the role which a more capable peer would play. For example, he/she can give an example which will stimulate the children's thinking, or can help them clarify ideas they have put forward. It should be emphasized that taking over the child's role is all that he/she does ; he/she is not expected to transmit verbally the knowledge to be acquired nor direct what the group is to do next. He/She indirectly supports the children's peer interaction, respecting their motivation for knowing, so that the interaction will effectively result in acquiring the knowledge. We will describe our model, which might be called an eco-social Piagetian model (or a dynamic Vygotskian model if you like), in more detail below, by using a case of the acquisition of "folklore" knowledge of making ice as an example.

Most of the knowledge acquired through children's peer interaction in daily life situations can be called folklore knowledge. This knowledge has the following features : a) it concerns an event in the natural world ; b) it is based on empirical evidence ; c) although it has some conceptual component, it is primarily procedural, and relatively isolated from other events as most people perceive them ; it can often be stated as [If we do X, then (it is likely to have) Y] or [In order to get Y, do X]. Let us give you an example. Suppose that day care children are allowed to sow flower seeds at any place

they like, and that they compare their results with one another. In this situation they are likely to get some knowledge on plant growth, such as "If we step on a place where the seeds are sowed, the buds will not come out," "If we do not give food (fertilizer), we cannot get big and lively flowers." "If we give too much water, the buds are not out." These are examples in folklore knowledge. Although in this case children do not understand mechanisms underlying plant growth, they acquire some procedural knowledge concerning what contributes to the growth of buds and blooms. In addition, they often acquire some conceptual knowledge as well through analogies with human beings. The following utterance by a child is a good example---"Flowers are like men. If flowers eat nothing, they will fall down of hunger. If they eat too much, they will become ill." (Motoyoshi, 1979, p.136).

Before going into details of our model, we would like to illustrate it with a brief description of how a number of children went about making ice (See the appendix for details), as observed by Motoyoshi, an experienced teacher of a day care center in Tokyo, and reported in her book (1979). Though probably incomplete as an observational document, in that the teacher (recorder) was likely to omit some events that did not attract her attention, this case is interesting in itself, because it shows that "folklore" scientific knowedge can be discovered through collective enterprise by day care children who have been encouraged in peer interaction, and we think it is quite useful to illustrate our model.

Making Ice

When several 5–6–year-old children were playing by stepping on a frozen swimming pool, one of them uttered a question. "Why are there days when the water of a swimming pool freezes and when it doesn't?" This question interested a group of children there. They were motivated to discuss this topic, and through this discussion they strengthened their motivation to know about this phenomenon. As a result, they decided to try to make ice by themselves. The children chose the vessels they liked and left them filled with water in the places they liked before they went home. Next morning they compared the results with one another in terms of whether or not the water in their vessels had frozen. Then they found that the water in the same kind of vessels did not always turn into ice with the same thickness, and that water in the vessels which had been put in the same place did not always freeze in the same way ; some froze and others did not. These findings motivated them to do "experiment" for making ice repeatedly for several days. On the ninth day, they could specify relatively well the conditions under which water freezes, i. e., they had acquired procedural knowledge about freezing.

A teacher joined this group as if she were an ordinary member. That is, she was engaged in the inquiry as the children were, but at the same time, she encouraged the children to continue their inquiry by showing interest in their ideas/motivation for knowing. For example, she permitted them to use any vessels and any places in the day care center they wished in order to examine their ideas. In addition, she sometimes took the role of a more capable peer when the peer interaction appeared to have come to a premature halt. For example, she stimulated children's thinking by giving a counterexample when the inquiry seemed to be about to stop because a majority of

children had accepted a wrong hypothesis.

Stages of Knowledge Acquisition

The processes of knowledge acquistion through peer interaction consist of cycles of four stages. A complete cycle comprises the following four stages, but there may be incomplete cycles as well ; one or two of the four stages, especially the third stage, is likely to be repeated ; the last stage of a cycle and the first stage of the following cycle sometimes overlap each other.

The first stage is characterized by the initiation of information seeking (or knowledge acquisition). Generally speaking, acqusition of knowledge is initiated by either epistemic curiosity (Berlyne, 1963 ; Hatano & Inagaki, 1971 ; Inagaki, 1982) or by the desire for inducing an event which people value in some sense, as in the case of alchemists. When these two motives are combined, the initation of information seeking must be accelerated. That is, when people are exposed to the non-occurrence of desirable state Y, contrary to their expectation, they are likely to be motivated to ask why, how, etc. and to seek further information.

We find a good example of this in "Making Ice." (See the 'Beginning' section in the appendix.) Here the joint arousal of the two motives contributed to the initiation of seeking further information. That is, the children desired to have a frozen swimming pool so that they could play on it, but they found that they could not always do it, since, to their unexpected disappointment, they had days without ice. This cognitive conflict was strengthened later by facing disagreement on the causes of freezing ; some children insisted that freezing was due to rain and others disagreed.

In the situation like this, we expect that children are likely to have such a question as "Why didn't it happen ?" When this type of question occur to them, we also expect they will either request an adult to give explanations, or continue the investigation by transforming it into a question such as "How can we make it happen ?" A question such as "How can we make it happen ?" is spontaneously asked by children in some cases ; in other cases it is asked intentionally by a teacher who wants the children to discover a new fact for themselves. Nagano (1970) insists that teachers should give young children the "manipulable" objective of producing the target phenomenon in order to motivate their scientific inquiry. In other words, teachers should ask such a question as "How can we make it happen ?" rather than why-questions in order to help children initiate the acquisition of knowledge. An utterance having the same function as this type of question is seen in 'Beginning' of "Making Ice", i. e., the proposal, "Let's try to make ice," offered by a child.

The second stage is that of the production of a number of hypotheses about the key question such as "How can make it happen?". That is, children are expected to produce hypotheses like "We can make it happen by doing X." The proponent of a hypothesis like "We can make it happen by doing X" may try to justify it on some ground, in order to make it persuasive to his/her peers. The following are seen as major justifications : a) justification based on the proponent's direct experience ; b) justification based on indirect experience, i. e., he/she has read or heard about it ; and c) deductive justification from his/her prior knowledge, e. g., meta-procedural knowledge. A concrete instance of the last category is a child's saying, "Plants need

sunshine in order to grow. The place by the fence is often in the sunshine. Therefore, if we plant a flower by the fence, it will grow well."

However, this does not mean that young children can always give such a justification. What are important here are that children can produce a number of hypotheses, and that some of them feel a certain hypothesis is so plausible that they consider it worth examining. Disagreement among children as to the truth of the hypothesis may even more strongly motivate its supporters to confirm it. On the contrary, when a majority of children come to accept a hypothesis, their inquiry may easily terminate at that point. One of the strategies which a teacher can use in this case is to give children a counterexample. We find a good example of such a strategy in "Making Ice". Here, seeing that a majority of children were about to agree to the idea that being placed inside prevented the water in the vessels from freezing, the teacher gave them a counterexample (See T2).

A reservation should be added : Hypotheses which children produce at this stage are expected to be different from the ones which adults produce in their scientific inquiry processes. That is, children rarely construct some explicit model involving mechanisms explaining the occurrence of observable event(s). Usually, their hypotheses are described in a procedural form. The child's utterance, "If we plant a flower in the sunshine, it will grow well", is a good example of it.

In "Making Ice" the second stage of the production of hypotheses is found several times. In some cases a hypothesis is implicit in that we can only infer its existence from what the children did and what they commented on it. It other cases a hypothesis is explicitly stated by children. A typical example of the former is found when children generated a hypothesis that some features of containers to hold water (particularly color and/or material) were critical. Before the children began experimentation, they did not state this hypothesis explicitly. However, we can infer that they had this hypothesis implicitly from their own behavior---they left a variety of containers filled with water---and utterances such as C11, "I could make ice in my bucket, but *Miho* couldn't, though *Miho* and I used the same kind of blue buckets." A good example of the latter, i. e., explicitly stated hypothesis, is seen in C20, "Let's leave the vessels in different places.", or C18, "First, I left my vessel inside. The ice I've got there was thin. Next day I left my vessel outside. I was able to get thick ice there. On that day the water in *Miho*'s vessel didn's freeze. I suspect *Miho* left her vessel inside." Children here seem to have had a "place" hypothesis, which regarded the place where containers were put as a critical factor.

The third stage of knowledge acquisition is that of experimentation. Children usually do not possess the scientific rigor of adults. There is only weak correspondence between a hypothesis to be examined and the experimental design in everyday inquiry by children. If a hypothesis is "If we do X, then we will get Y," the simplest test for children is to run an experiment by doing X all the time, without worrying about the control condition. As a matter of fact, however, some children who are against that hypothesis, will run an experiment by trying $\bar{X}$ (something other than X). Thus it becomes possible to compare the effects of X and $\bar{X}$ in the whole system. Although an ideal experimentation requires us to hold constant all the variables except X and $\bar{X}$, or

to change some variables systematically, children in fact are unlikely to control these variables. Consequently, the experimentation often contributes not only to confirm/reject a particular hypothesis but also to induce new questions. We see a good example of this in the experimentation based on the "rain" hypothesis in "Making Ice". That is, when the children were doing experiments according to the hypothesis that rain might be related to freezing, they encountered an interesting event, i. e., all the water in the same kind of vessels did not turn into ice with the same thickness, because they had failed to control the place variable. Although this experimentation confirmed the prediction that the water in the vessels froze even if it did not rain, at the same time it elicited a new question in the children, who failed to notice the difference of temperature between inside and outside. Thus their inquiry continued.

This third stage is also recognized several times in "Making Ice". A typical example is seen when children experimented by leaving their containers in various places, following the proposal of C20 involving "place" hypothesis. When the results of an experiment is found to be inconclusive, possibly another test will be run, usually adding refinements. Accordingly, when the children found that water in the same kind of vessels had not frozen in the same way, a more refined experiment where the place variable was to be held constant was done, as suggested by the proposal of C14, "Let's leave our containers in the same place." When the children found that no water in any vessels which had been put in the same place turned into ice, the same experiment was repeated, as C16, "Let's leave the vessels as they were once more." Needless to say, teacher's implicit encouragement would certainly contribute to having the experimentation continue. If the teacher had considered such experimentation unimportant or impossible in early childhood education, children's inquiry might well have been blocked out easily.

The fourth stage of knowledge acquisition is the collection of data and induction. Children reach a conclusion of their own through induction based on the results of the experiment (s). Two kinds of induction can be distinguished. One is schematic induction : Children derive a conclusion with confidence by applying their preexisting schema to incomplete data. A good example is seen in "Making Ice". Children there did experiments to confirm their "features of vessels" hypothesis, and left various vessels filled with water in the same place. When they found that only the water in a styrofoam vessel with a lid had not frozen, they were convinced, through this one observation, that the lid had prevented freezing (See the first four sentences in "Fourth Day" in the appendix). This is probably because it was consistent with their "shelter" schema ("Shelter reduces influence from outside."). The second type of induction is a cumulative one. This is primarily empirical induction based upon cumulative experience. The knowledge about conditions of freezing which children expressed in "Ninth Day" was a product of their cumulative induction.

This fourth stage of knowledge acquisition is also recognized several times in "Making Ice", following the experimentation(s). C8, "Now I understand. The water in vessels freezes even if it doesn't rain.", represents this stage. A new question sometimes occurs in parallel with the stage of data collection and induction about the old one. The original question is to examine whether or not doing X causes Y, but it can

be found that doing X in fact causes different Ys in terms of grade. Then children are likely to pursue a new question of what differentiates Y_1 from Y_2. If they can transform this question into such a form as "How can we make Y_1 and Y_2 happen?", this inquiry will proceed further. In a continuous inquiry process like this, investigation often goes on even if there is no difference between Y_1 and Y_2 in terms of practical value. A good example of it is seen in "First Day" of "Making Ice". At the beginning, children were oriented to make ice (Y), probably in order to use it in playing afterwards. Thus they were eager to confirm whether the water would turn into ice even if it did not rain. However, when they examined the result of the experiments in relation to the "rain" hypothesis, they found out the new fact that the water in some vessels turned into thick ice (Y_1), while the water in other vessels turned into thin ice (Y_2). This finding motivated them to know what factor contributed to the difference (See the utterances of C9 and C10). Then those children continued their inquiry ; they seemed to have an implicit hypothesis that features of vessels might be related to freezing. The inquiry which children were engaged in at this point possibly changed from usefulness-oriented, where making ice had some practical utility (as a means of playing afterwards), to knowledge-oriented (or epistemic), where knowledge was sought for its own sake. This change will have contributed to produce deeper understanding.

Notes

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REFERENCES

Berlyne, D. E. Motivational problems raised by exploratory and epistemic behavior. In S. Koch (ed.) *Psychology : A study of a science.* Vol. 5, New York : McGraw-Hill, 1963.

Hatano, G. & Inagaki, K. *Intrinsic motivation in development and education.* Tokyo : Meiji-Tosho, 1971. (in Japanese).

Inagaki, K. Motivation for knowing. In G. Hatano (ed.) *Handbook of cognitive psychology,* Vol. 4. Tokyo : University of Tokyo Press, 1982 (in Japanese).

Doise, W., Mugny, G. & Perret-Clermont, A. Social interaction and development of cognitive operations. *European Journal of Social Psychogy,* 1975, **5**, 367-383.

Duckworth, E. Piaget rediscovered. In R. E. Ripple, & V. N. Rockcastle (eds.) *Piaget rediscovered.* New York : Cornell University, 1964.

Miller, S. A. & Brownell, C. A. Peers, persuasion and Piaget : Dyadic interaction between conservers and non-conservers. *Child Development,* 1975, **46**, 992-997.

Motoyoshi, M. *Essays on education for day care children ; emphasizing daily life activities.* Tokyo : Froebel-Kan, 1979. (in Japanese).

Murray, F. B. Acquisition of conservation through social interaction. *Child Development,* 1972, **6**, 1-6.

Nagano, S. Subject-matter study for scientific play collection of new scientific play activities. *Young Children and Their Education* (Yōji to Hoiku)---, 1970, *July (separate issue),* 186-189. (in Japanese).

Perret-Clermont, A. *Social interaction and cognitive development in children.* London : Academic Press, 1980.

Piaget, J. *Etudes sociologiques.* Geneva : Droz, 1965.

Piaget, J. *Psychologie et pédagogie.* Paris : Donoël, 1969.

Vigotsky, L. S. (ed. & transl. by M. Cole, S. Scribner, V. John-Steiner, & E. Souberman) Cambridge, MA : Harvard University Press, 1978.

Appendix—Making Ice

Beginning

Several 5–6–year-old children were playing by stepping on the frozen swimming pool in a day care center. This activity was initiated spontaneously by these children. A teacher joined them later.

C1 : The water of the swimming pool isn't frozen hard today. The surface ice is thin. We can't step on it. It was frozen hard both yesterday and the day before yesterday, so I thought it must be frozen today, too.

On the following morning the swimming pool had no ice at all. The children were discussing this with one another as follows :

1 C2 : Didn't the water of the swimming pool freeze because it didn't rain?
C3 : No. It has frozen without rain.
C4 : Why didn't it freeze today, then?
C5 : .....
C6 : It's strange.
C7 : Let's try to make ice.

2 Then, these children left a variety of vessels filled with water anywhere they
3 liked before they went home. (Since other children who heard about the "experiment" for making ice, and were interested, joined the original group, about 13–14 children participated in this activity.)

First Day

Next morning they found that the water in almost all the vessels had frozen.

4 C8 : Now I understand. The water in vessels freezes even if it doesn't rain.
C9 : Look, Miss M (teacher), the ice in *Hayato*'s and *Miho*'s buckets is thin.
1 C10 : Why is their ice so thin? [Although only *Hayato* and *Miho* had put their buckets inside, no children seemed to notice it.]

2 Then children decided to continue this activity of making ice. They left the
3 containers filled with water when they went home. The containers chosen by them were varied : empty cans, bottles, jars, plastic and wooden buckets, styrofoam vessel, basin, etc.

Second Day

The water in the containers of all children except for three *(Miho, Takako,* and *Yoshinori)* froze. The ice in *Makoto*'s container was thick.

4 C11 : It's strange. I could make ice in my bucket, but *Miho* couldn't, though *Miho* and I used the same kind of blue bucket.
1 C12 : *Yoshinori* and *Kyosuke* used the same kind of jam jars, but *Yoshinori* couldn's make ice. [*Miho, Takako,* and *Yoshinori* had put their containers inside, but children did not notice that.]

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* Taken and translated from Motoyoshi (1979).
* C shows child's utterance ; T shows teacher's utterance.
* Numerals attached to C/T show the order of utterance.
* Numerals on the left side show the stages of knowledge acquisition.

C13 : It's puzzling, isn't it?

2 C14 : Let's leave our containers in the same place.

3 Following C14's suggestion, children left their containers together at a corner of the porch.

Third Day

The water in the containers which had been at the porch did not freeze at all.

4 C15 : It's strange. I wonder why we couldn't make ice. I suspect it is due to the fact that all of us put our vessels in the same place.

C16 : Let's leave the vessels as they were once more.

3 This proposal was accepted by the other children. They left their containers put in the same place as they did the day before.

Fourth Day

The children were pleased to find that the water in nearly all the containers had frozen. However, one of the children, *Kayoko*, complained with a tearful face, "The water in my vessel didn't freeze." *Kayoko*'s vessel was a styrofoam one with a lid. When children found this fact, they concluded that the lid had prevented freezing.

C17 : The water in *Miho*'s and *Yoshinori*'s vessels froze today.

4 C18 : First, I left my vessel inside. The ice I've got there was thin. Next day I left my vessel outside. I was able to get thick ice there. On that day the water in *Miho*'s vessel didn't freeze. I suspect *Miho* left her vessel inside.

T1 : *Miho*, did you leave your vessel inside?

C19 : I saw *Miho* putting her vessel on the locker every day.

T2 : I left my vessel inside of the front door, but you see, it is frozen.

2 C20 : Let's leave the vessels in differnt places.

3 Following C20's proposal, children left their containers in various places, such as behind a storeroom, at a sunshiny porch, on the south side of a henhouse, in a washroom, on the north side of the day care center building, in their playroom, and in a staff room.

Fifth and Sixth Days

3 It did not freeze at all on the first and second days after the children began to do this new "experiment".

Seventh Day

Only six vessels, which had been put on the north of day care center building, were frozen. The ice in one of them, *Makoto*'s can, was thick and hard.

Ninth Day

On the ninth day after children began to engage in the activity for making ice, they expressed their ideas on freezing as follows :

a) There are days when water in the vessels freezes and when it doesn't.

b) Even if water in the vessels left inside does not freeze, we cannot say that water outside will not freeze as well.

c) It is strange that the water in some vessels turns into thick ice, while in

4 others, thin.

d) The water in *Makoto*'s vessel always turned into thick ice. His vessel was a shallow cookie-can.

e) When we left the bucket full of water (outside), the water on the top froze, while the water at the bottom didn't. Thus the water at the bottom is warm, I suspect.

f) The rain was nothing to do with freezing. The water seems to freeze on cold days.

g) The water in *Kayoko*'s styrofoam vessel did not freeze hard, even when she removed the lid. It seems to be warm.

ALTRUISTIC BEHAVIOR, SOCIAL COGNITION AND PERSON ORIENTATION IN PRESCHOOL CHILDREN

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Altruistic behavior in 4 to 6-year-old children was examined in relation to social cognitive ability and level of person orientation. It was hypothesized that both information about social cognitive ability and about person orientation are required for predicting whether children will show altruistic behavior in natural situations. Fifty-eight boys and 59 girls were observed in free play sessions for 50 minutes, during which altruistic behavior and person-oriented behavior were recorded. Social cognitive ability was assessed by a perspective-taking test and an empathy test. The results showed a significant main effect of sex and level of person orientation, and an interaction between social cognition test scores and level of person orientation. There was no main effect of social cognition test scores. As hypothesized, those children who scored high in both social cognitive ability and person orientation showed altruistic behavior most frequently. However, this effect was produced by the results for the girls only.

Key words : altruistic behavior, social cognitive ability, person orientation, sex difference.

Children's social cognitive ability, such as perspective-taking or empathy, has been recognized as providing cognitive and/or motivational bases for altruistic behaviors (Hoffman, 1975, 1978; Mussen & Eisenberg-Berg, 1977). According to Hoffman, it is predicted that altruistic behavior is motivated by empathizing or understanding cues from another person which indicate a need for comfort, sharing or helping. Mussen and Eisenberg-Berg suggested that a large portion of the variability in altruistic behaviors would be predicted by the level of social cognitive ability. However, the empirical data have been somewhat ambiguous. Some researchers have reported that social cognitive ability is significantly related to altruistic behaviors (e. g. , Ahammer & Murray, 1979; Buckley, Siegel & Ness, 1979; Iannotti, 1978), but some researchers have not found any substantial relationship between the two (e. g. , Barrett & Yarrow, 1977; Emler & Rushton, 1974; Rushton & Winer, 1975; Waxler, Yarrow & Smith, 1977). These results suggest that the level of social cognitive ability does not provide sufficient information for predicting altruistic behavior. One of the reasons for these ambiguous results may be that researchers have considered the relationship between social cognitive ability and altruistic behavior too simply. Hoffman (1978) has suggested that a person who empathizes or understands the distress of another person does not necessarily behave altruistically to him/her. Barrett & Yarrow (1977) reported that whether someone will behave altruistically to another person in distress is partly dependent upon personality variables such as self-assertiveness or social toughness. Berndt (1981) pointed out the importance of motivational factors mediating socio-cognitive processes

and altruistic behavior. However, we have very limited knowledge about such variables as these.

In this study, the dimension of person orientation, which has been found to be a salient and stable aspects of individual differences throughout the preschool years (Emmerich, 1964 ; Jennings, 1975 ; Scaefer, 1971), will be considered in relation to social cognitive variables. Person orientation was chosen for study for two reasons : First, in most previous studies, empathy or perspective-taking are equated with social cognitive ability, and are measured by tests carried out independent of real social context. Researchers have believed that the level of social cognitive ability would provide the information about the basic ability needed in order to empathize or understand the feeling of another person in distress. But, whether children would actually empathize would not be determined by the level of social cognitive ability only. For example, if a child prefers to play alone or interact with objects, it would be expected that he/she would not as readily recognize cues from another person indicating a need for some intervention or assistance, even though he/she has a high level of social cognitive ability. A preference for interacting with others or for solitary play has been found to be a salient and stable aspect of individual differences throughout the preschool years (Emmerich, 1964 ; Jennings, 1975 ; Schaefer, 1971). Thus, it could be expected that information about the level of person orientation would be useful in predicting altruistic behaviors. That is, a child who prefers to interact with other children should be able to recognize cues from another in distress if only he/she has a high level of social cognitive ability. A child who prefers to play alone or interact with objects should be less apt to readily recognize such cues even though he/she has a high level of social cognitive ability. On the other hand, children who have low social cognitive ability should not be able to recognize cues of distress regardless of their level of person orientation, since they would have more limited ability understanding these cues.

Second, level of person orientation would also be related to the level of motivation for behaving altruistically. A child who is not person-oriented may be less motivated by another's distress since other persons are not salient to him/her as they are for a person-oriented child. Thus, it would be expected that social cognitive ability alone would not produce accurate predictions of altruistic behavior, and that both information about level of social cognitive ability and level of person orientation would be required for predicting whether children will actually show altruistic behavior in natural situations.

METHOD

Subjects

The subjects were 58 boys and 59 girls, ranging in age from 4 years 7 months to 6 years 10 months. They were all attending a public nursery school.

Procedure

The children were first tested using two social cognition tests : a perspective-taking test and an empathy test. These tests were administered to the subjects individually and required about 30 minutes with each child. The children then were

observed during their nursery school free hours both in the morning (9-10:30 a.m.) and in the afternoon (4-5 p.m.). Each child was observed for 5 ten-minute samples, 3 in the morning and 2 in the afternoon. Each observation sample consisted of 30 continuous 20-second units. The categories of behaviors observed including helping, comforting, sharing and group activity (cooperative and associative activity, as defined by Parten (1932)).

The reliability of observation was assessed by simultaneous 10-minute observations on 10 children by two independent observers. The reliability coefficients were 1.00 for altruistic behaviors, and .98 for group activities.

Measures

Altruistic behaviors. Altruistic behavior was defined as attempts to fulfill another's need for physical or emotional support. Those behaviors which occurred as a part of cooperative play and involved completion of a mutual goal were excluded. Three types of altruistic behaviors were recorded : helping behavior, comforting behavior, and sharing behavior. Helping behaviors were those in which the child assisted another person either physically or by giving some information, or helped another in some task. Comforting behaviors were those in which the child expressed sympathy in physically or in vocal terms or tried to make another feel better when in distress. Sharing behaviors were those in which the child either gave away, or allowed the temporary use of material belonging to, or being used by, themselves.

Person orientation. The amount of participation in group activities (i. e. associative and cooperative activities) was used as an index of person orientation. While other studies (Barnes, 1971 ; Parten, 1932) have considered such group activities as an index of social development, recent studies have shown that involvment/non-involvment in these activities does not necessarily indicate level of social development (Moore, Everton & Brophy, 1974 ; Rubin, Maioni & Hornung, 1976 ; Smith, 1978). Rather, these studies suggest that whether a child interacts with peer or not may be instead a reflection of a preference for group vs solitary play. Thus participation in these activities was used here as a measure of person orientation.

Social cognition tests. A perspective-taking test and an empathy test were administered. The perspective-taking test was similar to that used by Kurdek (1980). The child was given a revolving tray on which three different dolls were glued ; the tester had an identical one. While seated opposite the child, the tester successively rotated his tray to each of four positions in the following order : 0, 90, 270, and 180 degrees from starting position. After each turn, the child was instructed to turn his/her tray so that he/she could see doll the same way as the tester could. Correct responses were scored as 1, and the total scores ranged from 0 to 4.

The empathy test was developed by Ujiie and Furuta (1981). The child was given two sets of four pictures each. Each picture showed animals at work and expressed an emotion. The tester asked the child to explain what the animal in each picture was doing. The first picture in each set was for practice ; the explanation for the remaining six pictures were scored. When the child's response was expressed in terms of the animal's feeling or inner state, it was regarded as an empathetic response. Children who did not give empathetic response spontaneously were asked the probe 1

question : "What is he feeling?" The probe 2 question was asked when the probe 1 question did not yield the desired responses : "Is he happy?" or "Is he angry?" and so on. Only spontaneous empathetic responses were used in this analysis. They were scored as 1, and the total scores ranged from 0 to 6.

The combined scores of the perspective-taking and empathy tests were used as the measure of social cognitive ability.

RESULTS

Observational data

The mean frequencies of altruistic behaviors are summarized in table 1. The most frequent altruistic behavior was helping behavior, which was observed in 52% of the children (mean=1.71). Comforting was observed in 23% of the children and sharing was observed in 17% of the children (mean=. 39, .30, respectively). Since sharing and comforting behaviors were relatively infrequent, sharing and comforting were combined into a single category with helping behaviors ; these three behaviors comprised the altruistic behaviors in the study. Altruistic behaviors were observed in 67% of the children, and the mean occurrence was 2.39.

TABLE 1

Mean frequency of each category of altruistic behavior and proportion of altruistically behaved children

Category	Mean	SD	Range	Proportion
Helping	1.71	3.44	0—27	61 (52%)
Comforting	0.39	0.84	0— 5	27 (23%)
Sharing	0.30	0.30	0— 6	20 (17%)
Altruistic behaviors	2.39	3.98	0—27	78 (67%)

ANOVA

To test the hypothesis, a three-way analysis of variance was performed : social cognition test scores x person orientation x sex. For the analysis, subjects were divided into high and low categories, using the medians of the social cognition test scores and person orientation scores. The means of this analysis are shown in table 2, and the results of the ANOVA are summarized in table 3.

The ANOVA yielded main effects of sex and person orientation. Girls behaved more altruistically than boys, $F(1,109) = 8.79$, $p < .01$; high person-oriented children behaved more altruistically than low person-oriented children, $F(1,109) = 4.81$, $p < .05$. There was no effect of social cognition test scores.

A significant interaction between sex and level of person-orientation was found, $F(1,109) = 10.50$, $p < .01$. Only for girls, highly person-oriented children behaved more altruistically than low person-oriented children ($p < .05$, Ryan's test), and there were no differences among the other three groups of children. For boys, altruistic behaviors were equally low over all four conditions ; that is, for boys, neither social cognition

test scores nor person orientation scores produced any effects.

TABLE 2

Mean frequency of altruistic behavior

Level of social cognitive ability	Girls		Boys	
	Level of person orientation[a]		Level of person orientation[a]	
	High	Low	High	Low
Low	3.54 (3.10) N=13	1.55 (2.33) N=20	1.87 (2.33) N=15	1.91 (1.81) N=11
High	7.42 (9.28) N=12	2.07 (1.54) N=14	0.55 (0.89) N=20	2.08 (3.09) N=12

a) Numbers in parenthese indicate SD.

TABLE 3

Summary of ANOVA for altruistic behavior

Variables		MS	df	F
Sex	A	114.29	1	8.75**
Person orientation	B	62.84	1	4.81*
Social cognitive ability	C	27.84	1	2.13
A X B		137.21	1	10.50**
A X C		9.37	1	0.71
B X C		61.38	1	4.71*
A X B X C		14.78	1	1.13
Error		13.07	109	

* $p < .05$
** $p < .01$.

DISCUSSION

The present findings support the hypothesis that only children with both high social cognitive ability and high person orientation would behave altruistically ; but the hypothesis is confirmed only for girls. While the ANOVA yielded a main effect of person orientation, it also yielded an interaction between social cognition test scores and person orientation. The children who had high social cognitive ability did not show much altruistic behaviors, unless they also tended to orient toward other persons. Thus, it is possible to say that both information about social cognitive ability and about person orientation are needed in order to predict altruistic behavior.

A significant sex difference was found in this study in which girls were found to behave more altruistically than boys. The issue of sex differences in altruism is a complex one. For example, Mussen and Eisenberg-Berg (1977) reviewed and com-

mented that there were many findings that indicated n: sex differences. However, there have been other studies that report sex differences. In their cross-cultural study, Whiting and Pope (1973) found that girls produced helping and supporting acts more than boys in six cultures including Japanese society. There is a possibility that Japanese girls are encouraged to offer helping or caring to other children, especially younger children, whereas these behaviors are not expected for boys. Although all the effects in this study were found to be true only for girls, the lack of effect for the boys may have been due to the fact that their scores were overall too low for any variations to be significant. There is a need for further research on sex differences in altruistic behavior.

In the previous studies which examined social cognitive ability as a predictor of altruistic behavior, researchers have overlooked information about opportunities to act altruistically, and motivation to interact prosocially with other persons. As indicated in the present results, social cognitive ability alone cannot completely predict altruistic behavior. Rather, social cognitive ability operates in interaction with the level of person orientaion, and these two variables together predict altruistic behavior. Therefore, it is not surprising that the results of previous research have been ambiguous, since levels of person orientation were not considered. In this study, however, an overall frequency of altruistic behavior was used. Further research might investigate in more detail the effect of social cognitive ability and person orientation in predicting actual responses to individual opportunities for altruistic behavior.

REFERENCES

Ahammer, I. M., & Murray, J. P. 1979 Kindness in the kindergarten : The relative influence of role playing and prosocial television in facilitating altruism. *International Journal of Behavioral Development*, 2, 133–157.

Barnes, K. E. 1971 Preschool play norms : A reprication. *Developmental Psychology*, 5, 99–103.

Barrett, D. E., & Yarrow, M. R. 1977 Prosocial behavior, social inferential ability, and assertiveness in children. *Child Development*, 48, 475–481.

Berndt, T. J. 1981 Relations between social cognition, nonsocial cognition, and social behavior : the case of friendship. In J. H. Flavell & L. Ross (Eds.), *Social cognitive development : frontier and possible future*. New York : Cambridge University Press.

Buckley, N. B., Siegel, L. S., & Ness, S. 1979 Egocentrism, empathy, and altruistic behavior in young children. *Developmental Psychology*, 15, 329–330.

Emler, N. P., & Rushton, J. P. 1974 Cognitive-developmentz. factors in children's generosity. *British Journal of Social and Clinical Psychology*, 13, 277–281.

Emmerich, W. 1964 Continuity and stability in early social development. *Child Development*, 35, 311–332.

Hoffman, M. L. 1975 Developmental synthesis of affect and cognition and its implication for altruistic motivation. *Developmental Psychology*, 11, 607–622.

Hoffman, M. L. 1978 Empathy, its development and prosocial implication. In C. B. Keasy (Ed.), *Nebraska symposium on motivation*. Lincoln : University of Nebraska Press.

Iannotti, R. J. 1978 Effect of role-taking experiences on role-taking, altruism, and aggression. *Developmental Psychology*, 14, 119–124.

Jennings, K. D. 1975 People versus object orientation, social behavior and intellectual abilities in preschool children. *Developmental Psycholgy*, 11, 511–519.

Kurdek, L. 1980 Developmental relations among children's perspective taking, moral judgment, and parent-rated behaviors. *Merril-Palmer Quarterly*, 26, 103–121.

Moore, N. V., Everton, C. M., & Brophy, J. E. 1974 Solitary play :Some functional reconsiderations. *Developmental Psychology*, 10, 830–834.

Mussen, P., & Eisenberg-Berg, N. 1977 *Roots of caring, sharing, and helping*. San Francisco ; Freeman & Company.

Parten, M. B. 1932 Social participation among preschool children. *Journal of Abnormal and Social Psycholgy*, 27, 243–279.

Rubin, K. H., Maioni, T. L. & Hornung, M. 1976 Free play behavior in middle and lower-class preschoolers : Parten and Piaget revised. *Child Develoment*, 47, 414–419.

Rushton, J. P., & Winer, J. 1975 Altruism and cognitive development in children. *British Journal of Social and Clinical Psychology*, 14, 341–349.

Schaefer, E. S. 1971 Development of hierachical, configurational models for parent behavior and child behavior. Is J. P. Hills (Ed.), *Minnesota symposia an child psychology* (vol.5). Mineapolis : University of Minnesota Press.

Smith, P. K. 1978 A longitudinal study of social participation in preschool children : Solitary and parallel play reexamined. *Developmental Psychology*, 14, 517–523.

Ujiie, T., & Furuta, Y. 1981 Prosocial behavior and its correlates in nursery school children. *Annual report* 1979–1980, RCCCD, Faculty of Education, Hokkaido University.

Waxler, C. Z., Yarrow, M. R., & Smith, J. B. 1977 Perspective-taking and prosocial behavior. *Developmental Psychology*, 13, 87–88.

Whiting, B., & Pope, C. 1973 A cross cultural analysis of sex differences in the behavior of children aged three through 11. *The Journal of Social Psychology*, 91, 171–188.

RESEARCH NOTE

YOUNG CHILDREN'S RECOGNITION OF THEIR OWN IMAGE

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It has been suggested by many researchers that awareness of one's own body as a physical entity apart from others is the starting point for development of a self-identity. This research investigated the young child's ability to discriminate an image of himself/herself from that of other people.

Subjects were 119 young children from one to six years of age, who were attending either a nursery school or a day care in Asahikawa.

There were two types of tasks. In the first task, the subjects were asked to select their own picture out of a set of pictures. There were two comparison sets used : the first consisted of the subject and several other children of the same age. The second set consisted of the subject and persons of various ages. For each comparison set, photographs were taken of the individuals within the set from three different perspectives : front, side and back.

Thus, there were a total of six comparison sets of photographs presented to the subjects, each containing eleven photographs, from which the subject was asked to select his/her own image.

In the second task, the subjects were presented with four sets of line drawings and asked to select the picture that was most similar to themselves. The sets of drawings included a total of seven cards depicting the following : a body part (head, trunk, legs) or whole figure of a standing child, a kangaroo, a spaceman, a robot, a tower of blocks, a sun-flower, and an umbrella.

In considering the results of the first task, in which the subjects were asked to select the photograph of themselves from that of other individuals, two questions were asked : (1) At what age can children discriminate their own image from that of others? (2) What effect is there on their ability to discriminate when the photographs are taken from different perspectives? The results of the first task are shown in table 1.

Overall, there were no age diferrences, except for the significantly low performance of the one-year-olds relative to the other growps. However, since these youngest subjects were probably not able to fully understand the task, this difference was to be expected.

The perspective of the photographs showed some effect on the children's ability to recognize their own image : front perspective photographs produced the highest rate of correct responses, side perspective photographs were recognized less often, and the lowest rate of correct response was found for back perspective photographs.

TABLE 1

Percentage of correct choices of his/her own photo

Age group	N	From among 11 photos of the persons of various ages			From among 11 photos of the children of the same age		
		front	side	back	front	side	back
Six	21	100	100	100	100	100	100
Five	25	100	88	88	100	100	100
Four	21	100	90	95	100	100	95
Three	21	100	90	86	100	90	90
Two	21	95	76	57	95	81	62
One	10	50	40	10	30	10	10

The second task required that the subjects select the picture that was most similar to themselves from a comparison set that included a body part and other objects. The results of this task are shown in tables 2 and 3.

TABLE 2

Percentage of correct choices of the picture of body part/figure

Age group	N	Card			
		Head	Trunk	Legs	Whole body
Six	21	90.5	80.9	95.2	95.2
Five	25	84.0	72.0	92.0	84.0
Four	21	61.9	47.6	52.4	52.4
Three	21	28.6	23.8	28.6	23.8
Two	21	28.6	9.5	14.3	33.3

TABLE 3

Percentage of errors of total responses

Age group	N	Card							
		Head		Trunk		Legs		Whole body	
		A	B	A	B	A	B	A	B
Six	21	9.5	0	19.1	0	0	4.8	4.8	0
Five	25	16.0	0	28.0	0	4.0	4.0	16.0	0
Four	21	23.8	14.3	28.6	23.8	23.8	19.1	28.6	19.1
Three	21	47.6	23.8	47.6	28.6	38.1	28.6	42.9	33.3
Two	21	47.6	14.3	42.9	33.3	42.9	28.6	23.8	33.3

A refers to the pictures similar to human body.

B refers to the pictures dissimilar to human body

In overall performance, four-year-olds were better able to correctly select the picture of the body part/figure compared to three-year-olds ; and correspondingly, five-year-olds were more accurate than four-year-olds. Regarding the results for each set of cards, significant differences were found between the ages of three and four in recognizing the head as the object most similar to the subject ; and a difference was also found between the ages of four and five in recognition of the legs and whole body.

In conclusion, the results show that children are able to recognize their own image from among a group of photographs of individuals from at least age two ; however, this task is more difficult for them when the photographs are presented in side and back perspectives. Also, the results have shown that young children gradually learn to recognize body parts as objects that are most like themselves, when presented with a set of different objects from which to select. Errors in selection are at first generally random ; however, as children become more able to correctly select the human figure/body part, their incorrect selections are increasingly those of objects that are more similar to a human being (e.g., robot vs. tower of blocks).

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